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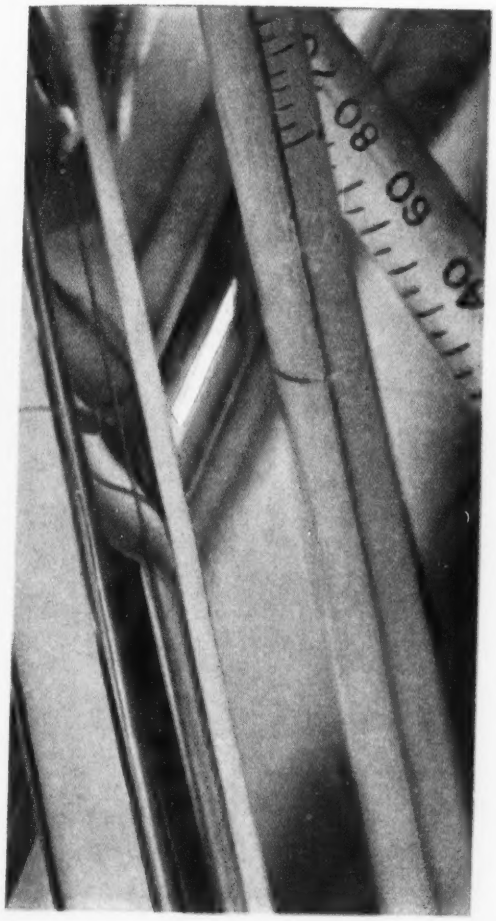

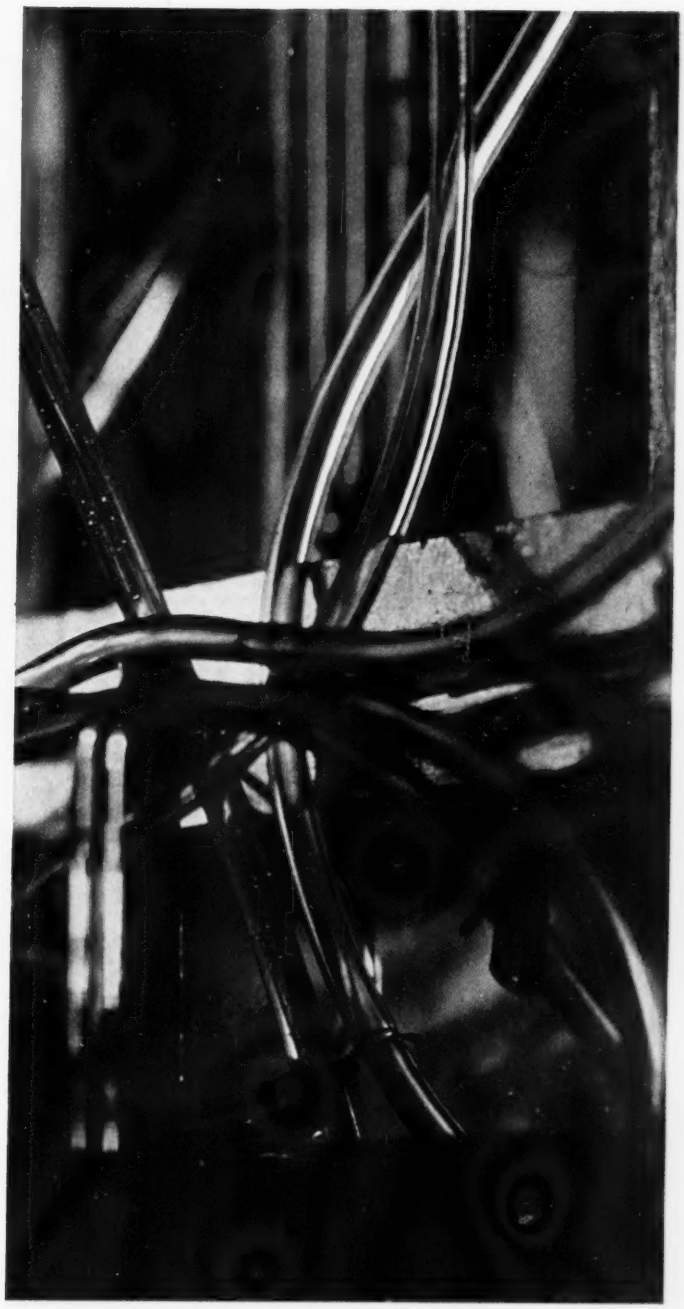

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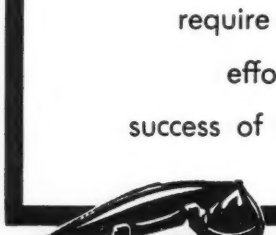

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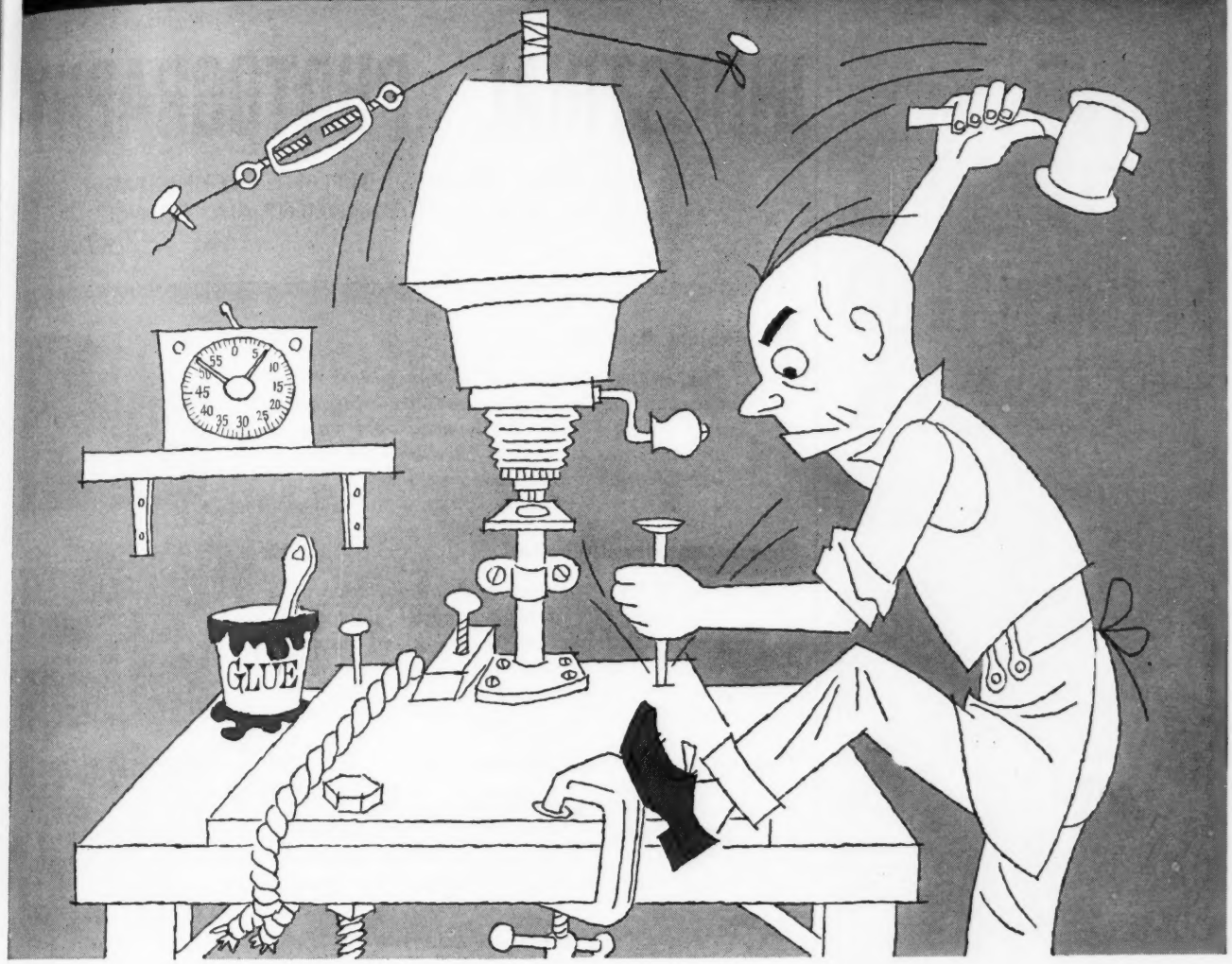

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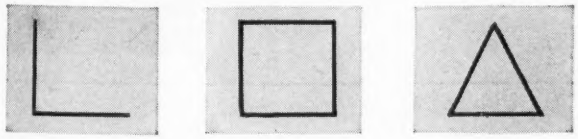

4 triangular trusses—4 points of support —10 points of rigidity reduce vibration to barest minimum in the Beseler 45MCR-X.

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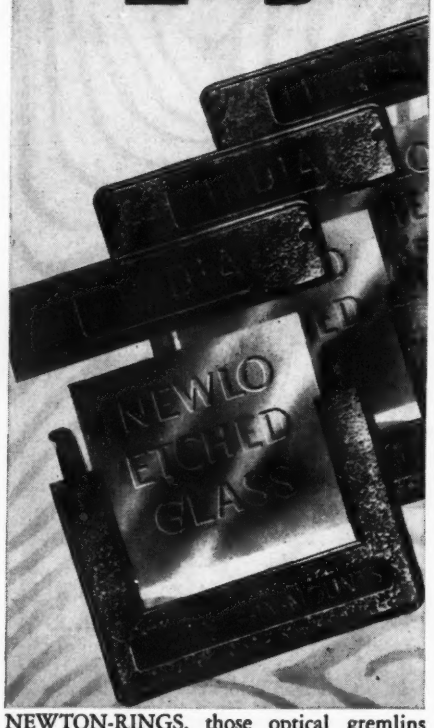

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INDUSTRIAL PHOTOGRAPHY

THE MAGAZINE SERVING IN-PLANT TECHNICIANS IN BUSINESS, INDUSTRY, GOVERNMENT AND SCIENCE

A Complete Package 32

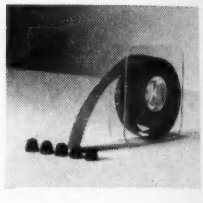
That's what the M.I.T. Photographic Service delivers. In the Graphic Arts Building Manager Frank Conant holds sway over portrait and illustrative studios, 12 darkrooms and a host of other reproduction facilities.

Photogrammetry Unlimited 34

The M.I.T. Photogrammetry Lab, once used exclusively for teaching aerial photogrammetry as a branch of surveying and mapping, now conducts research and development for photogrammetric systems.

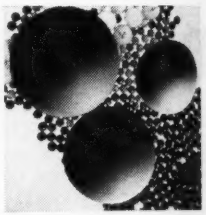
Preparation of Printed-Wiring Masks 36

Lincoln Laboratory technicians have found a unique way to eliminate distortion introduced while photographically reducing master drawings to working size in making photographic masks for precision etched wiring.



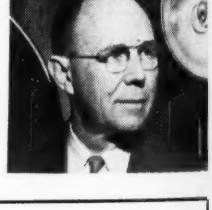
Photography & the Visual Arts 38

Experimentation in the photographic medium helps M.I.T. students overcome visual illiteracy and develop a critical understanding of art in an age increasingly dependent on perceptual awareness.



Edgerton of M.I.T. 40

Meet the remarkable "Doc," who has revolutionized photography, created new industries and unlocked treasure chests of knowledge for the host of students who study high-speed techniques under him.



ABOUT THE COVER: With a creative camera finite shapes in the lab assume an abstract aura. Such a camera was wielded by Simpson Kalisher, turned loose with color transparency film. Thermometers in a beaker (top) become a gleaming maze . . . Free form lines (middle) are tubes used to blow air through turbine oils in oxidation tests . . . Boiling water, oil and glass beads in neutralization number test turn into eerie composition. These photos appear through the courtesy of the Texaco Company.

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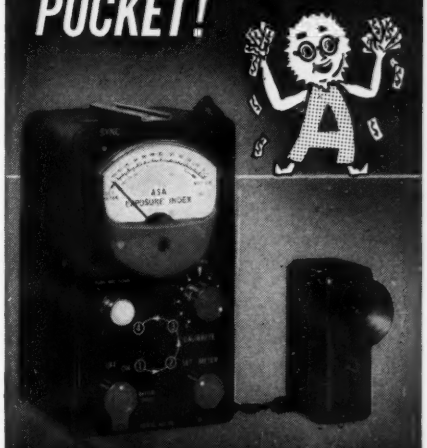

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HERE ARE A FEW OF THE PLACES WHERE FOTORITE IS MAKING PHOTOGRAPHIC HISTORY:

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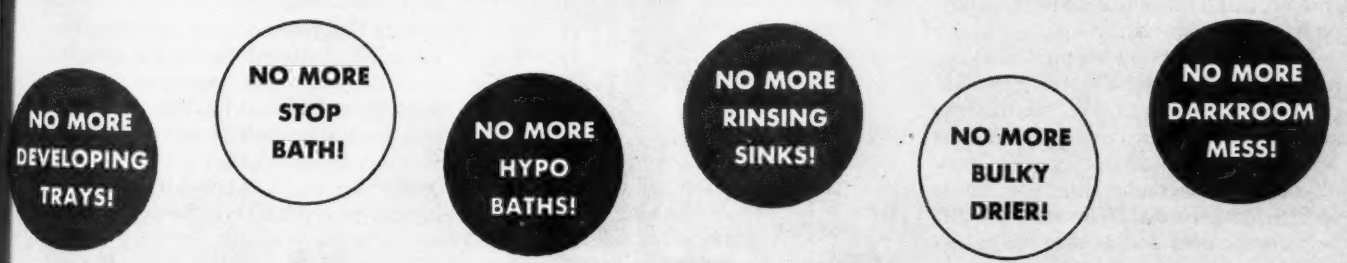
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Kodak PROFESSIONAL ROUND-UP

photographic non-fiction

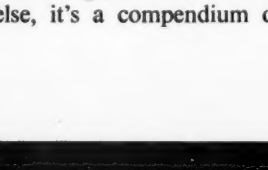
If you know all about our data books and guides and all they contain, don't bother to read on. Just go to the last column, tear it out, and keep it constantly on hand for reference.

You probably know we publish many more books than those listed in the last column—64 titles in all. The rest, though, are for our amateur customers, or deal with highly technical subjects like geophysical photography for the ultra-specialized specialist. The ones we list here are the ones pertinent to the industrial end of the business.

A lot of the material these books cover might seem elementary at first glance; on the other hand, when you have these little volumes around, you can be sure you have a source for quick answers to sudden questions when these answers have slipped out of mind in the press of important work.

So, to refresh a memory here or there, we'd like to present a sampling of the kinds of information Kodak Data Books contain; and for those of you who already know, we refer you again to that last column over there.

A short course



That isn't a picture of a Victorian Buck Rogers with a 19th century rocket belt, but an early wet-plate photographer lugging glass-for-coating, silver chloride, and nitrocellulose (plus his darkroom!) out to the site of an assignment. The picture comes from chapter 2, the historical section of "Photo Chemistry in Black-and-White and Color Photography."

For beginners in the studio, this booklet is almost like a regular class text. For everybody else, it's a compendium of theoretical and practical things. Like the atomic weights of metals and non-metals such as platinum and boron in developers and other processing solutions. The ion-exchange business that takes place as the developer activator starts to work. The maximum permissible concentration of residual hypo in mg. per square inch for commercial use. Conversion tables of U. S. Liquid and Metric Measures. And so forth.

Source: Kodak Data Book W-39.

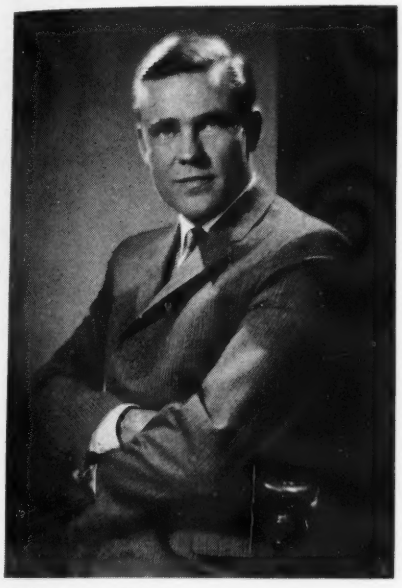
Better-looking bolts

"Studio Lighting for Product Photography" is for all those people who regu-

larly have to photograph small objects, perhaps for a company press release or annual report. The book covers lights, reflectors, tenting materials, possible backgrounds, and the like. No detailed descriptions of how to make screws look stronger or pharmaceutical pills more palatable; instead, the subject is treated in terms of basic photographic problems, and your skill will jump the gap between the general principles and the specific objects to be shot. Kodak Data Book number O-16.

And "Professional Printing..."

Subtitled " . . . with Kodak Photographic Papers." Exposure determination, special print techniques, finishing and toning. Need we say more, except that the number is G-5.



Color in and out

Two books, "Color Photography in the Studio" (No. E-76) and "Color Photography Outdoors" (No. E-75), contain much that is probably familiar, but they might also jog your memory on aspects of color work sometimes overlooked.

How about the three-quarter portrait pose, for instance? If you're ever called upon to photograph company personnel, do you use it? Some of the time? Part of the time? Never? If your answer is the last, the Data Book (E-76) on the color studio prods you into giving it a chance when you're working with ordinary tungstens because (a) the bigger camera-subject distance gives you more depth of field and (b) the bellows-extension factor is reduced—an increase of only about ⅓ stop being required, as opposed to an average ¾ stop for conventional heads-and-shoulders, and (c) the three-quarter pose is a nice way of getting around the antics of a jittery subject. The smaller image size makes movement less critical.

In "Color Photography Outdoors" (E-75), there are tidbits like the problems of color work in the tropics. Does the photographer whose company has plants in South America as well as South Dakota have more light in the tropic zone?

If you answered an unqualified yes, better read the book. On tropical locations where there are plenty of pale stucco houses and lots of sand, the light will indeed be brighter, but there is also the matter of tropical foliage—very dense and light-absorbing in most places. This means that in shrubby locations, exposure needs to be increased rather than cut down below the normal required for Temperate Zones. We aren't trying to arouse ire by flaunting tropical assignments when your company is located nowhere else but Minneapolis or Bangor; we just try to make each publication as inclusive and as helpful as possible to as many different people as possible, wherever you are.

...and color anywhere

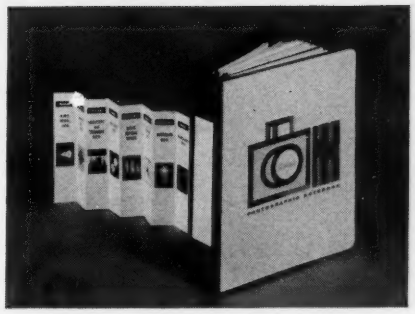
Regardless of where or what your color subject is, the Kodak Color Dataguide (No. R-19) is the one basic reference for the whole field. Organized into three sections, *Exposing*, *Processing* and *Printing*, it eschews theory and extensive explanation in favor of bedrock working information. Included in the guide are two computers, a gray card of 18% reflectance, a photographic gray scale, color control patches, a 35mm standard negative and sample color print, a set of viewing filters, nine color reproductions on correcting poor color balance and exposure, and a filter-pack chart. The guide is complete. Terse. And we might go so far as to say absolutely essential.

Darkroom construction, too

Data Book No. K-13—"Darkroom Design and Construction"—won't help much if you decide to modernize an in-plant studio or build a new one from scratch and want do-it-yourself instructions. What this data book does do is discuss planning of the whole setup—entrances and floor materials, wiring and plumbing, ventilation and bench constructions. Its aim is to assist you in talking precisely and fluently with your company engineers, electricians, shop people, and anyone else who would be involved in such a project.

And then there's the Photographic Notebook...

Properly using this notebook, its title strips, separator pages, and other devices enables you to build a one-location reference center. We know your Kodak Technical Representative is a walking reference center, but it's worthwhile having *your* set of data books



around in a notebook for the times he's on the other side of his territory.

Tear this out...

It lists Kodak publications pertinent to the activities of the industrial photographer. It covers those volumes which we think might, on occasion, help you to do a better job and build more business. Which, after all, is the only reason we'd ever want to publish the books (or this ad) in the first place.

Title	*No.*
Kodak Color Handbook	W-23
Kodak Industrial Handbook	W-25
Kodak Films (Black-and-White)	F-1
Filters and Pola-Screens	B-1
Precise 35mm Technique with the Kodak Retina Camera	C-31
Kodak Photographic Papers	G-1
Processing Chemicals and Formulas	J-1
Photo Chemistry in Black-and-White and Color Photography	W-39
Copying	M-1
Color as Seen and Photographed	E-74
Color Photography Outdoors	E-75
Color Photography in the Studio	E-76
Kodak Color Films	E-77
Printing Color Negatives	E-66
Professional Printing with Kodak Photographic Papers	G-5
Camera Technique for Professional Photographers	O-18
Negative Making for Professional Photographers	F-5
Studio Lighting for Product Photography	O-16
Studio Techniques for Portrait Photography	O-4
How to Organize and Operate Photographic Service Departments	P-17
Photographic Production of Slides and Filmstrips	S-8
Making Service Pictures for Industry	P-4
Industrial Motion Pictures	P-18
Magnetic Sound Recording for Motion Pictures	P-26
Kodak Master Darkroom Dataguide	R-20
Kodak Projection Print Scale	R-26
Kodak Neutral Test Card	R-27
Kodak Movie Photoguide	R-22
Kodak Master Photoguide	R-21
Darkroom Design and Construction	K-13
Kodak Color Separation Guide—7-inch	Q-13
Kodak Color Separation Guide—14-inch	Q-14

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BOLEX GETS THE IMPACT STORY FOR ACF INDUSTRIES

Bolt a Bolex 16mm camera to a freight car ready to bump?

Research engineers at ACF Industries, Berwick, Pa., devised such a test to measure impact and called their Photo Department. ACF photographers, who devote a majority of their time to taking research shots, thought the request outlandish. "Precision cameras are simply not built with this kind of usage in mind," they argued. But the engineers said it was necessary if the test was to succeed and considered the camera expendable. The 16mm Bolex was bolted to the freight car and . . . WHAM! The car was bumped against another freight car . . .

The 16mm Bolex recorded every jarring frame of the collision and came away good as new!

Another exacting assignment for Bolex was to help measure impact on ACF's retractable hitches for truck trailers riding piggyback on flatcars. Through analysis of the Bolex films, engineers could see in detail how the springing arrangement responded to loads.

As you can see, Bolex equipment gets plenty of rough use at ACF. Two Bolex 16mm cameras—with a variety of Switar and Yvar lenses—are mainstays. Neither Bolex, one of them 12 years old, has ever given a speck of trouble.

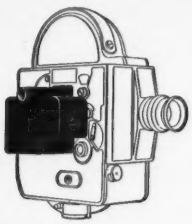
ACF photographers use Bolex because it is rugged, dependable and offers lightweight compactness and sharp picture quality.

•

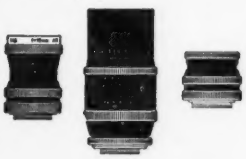
. . . Another example of Bolex getting the job done for the professional

Bolex Cameras and Accessories
For Every Professional Effect

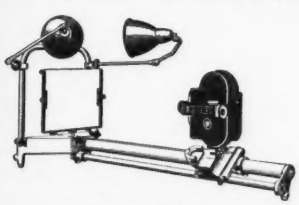
Bolex Tripod: *Lightweight aluminum construction. Smooth-action pan head tilts 135 degrees vertically. With cable release, $99.50.*



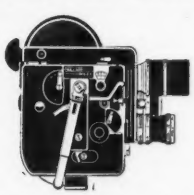
Bolex Unimotor: *Electric motor drives camera through full roll of film at constant speed. Batteries or AC current. $89.50.*



Precision-Ground Lenses: *Switar 10mm f/1.6 extreme wide angle, $149.50; Switar 25mm f/1.4 normal lens, $168.00; Switar 75mm f/1.9 extra-fast telephoto, $145.00.*



Bolex 16mm Super Titler: *Basic Kit—optical bench, main frame, two reflectors, title frame and sliding cradle—$180.50.*



Bolex H-16 Rex: *Reflex viewing, variable shutter, 3 lens turret. With superb Lytar f/1.8 lens—$450.00.*

Bolex cameras and accessories offer the utility for professional work many studios have paid thousands of dollars for. Write for literature and the name of your nearest Bolex dealer.

All prices include F.E.T. where applicable.

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BOLEX

Circle No. 582 on Post Card

editor's mail

mitchell badler, editor

A Warning

One of the August "Short Cuts" suggested using a copper tubing coil as an immersion heater. This item should have cautioned against using copper in developing solutions. The Eastman Kodak professional data book titled *Negative Making for Professional Photographers* says: "Fog can also be caused by chemical contamination of the developer, as might result from using soldered tanks or placing a copper cooling coil in the developer." — Nils C. Noaker, Photographic Manager, U.S. Army War College, Carlisle Barracks, Pennsylvania.

Another reader made the same comment. However, he pointed out that stainless steel tubing would do the same job and not contaminate the developing solution, thus ruining a batch of negatives in very short order.

From an Engineer

I am interested in becoming an industrial photographer, and would like information on the training and education needed. As a senior at Auburn University who has majored in chemical engineering I would like to know if a degree in this field would be of much use in the field of industrial photography? — Robert J. Danos, 320 W. Magnolia, Ave., Auburn, Ala.

For an authoritative answer we called on Dick Derby, scientific photographer at General Mills. Derby was a chemistry major with an interest in photography when he was hired originally by GMI. Here are excerpts from his answer to Danos:

"Certainly the study and the knowledge and the techniques gained in meeting the requirements for a chemical engineering degree should be useful in many related fields, and I feel industrial photography would be included—at least many of its areas. If you were to do photography for an organization primarily engaged in chemical engineering the advantages of the degree would obviously be optimum — provided you were a good photographer. I am sure that there is always a need for those who are expert photographers and also have an understanding of other professions.

If you are interested in industrial photography, the prime consideration is to get a working background in it. I think you will find many photo units are not too degree-conscious. When applying for a photo job the main question will be in reference to your photo ability and background.

My personal feeling is that if you have a good background in chemical engineering you should stick to it. This is a very green field. My degree has been used many years more for work in chemistry than in photography. However, when I needed photography to advance my work I used it.

I am sure that if you write to other photographers in this business you will get an entirely different answer. But I hope these few remarks will be helpful to you. — Richard I. Derby, General Mills Research Laboratories.

Space Photography Pros

All of our staff feel that your June "Man In Space" issue represents the most accurate and comprehensive document yet published on space photography. —Frank Colella, Jet Propulsion Laboratory, Pasadena, Calif.

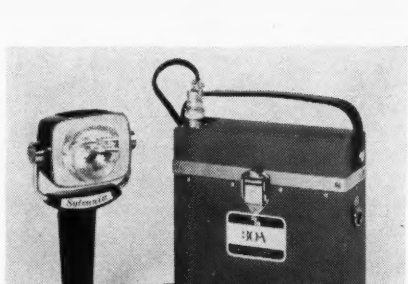
new products

reviewed by bert lefkowitz

While lighting packages have been available for some time to provide illumination on locations lacking AC, they have admittedly been heavy and the lamps themselves slightly unwieldy. This month the long awaited adaptation of the Sylvania Sun Gun has been released to the photographic fraternity and it certainly is an attractive package. The power pack reflects the experience of Jim Frezzolini, well known in newspaper circles, and contains heavy duty nickel cadmium batteries. The halogen tube has been incorporated in a special design requiring only 30 volts and will burn continuously for 32 minutes from one charge. The unit is of course equally useful for shooting stills and has the advantage of a light source that can be placed and measured accurately before exposure.

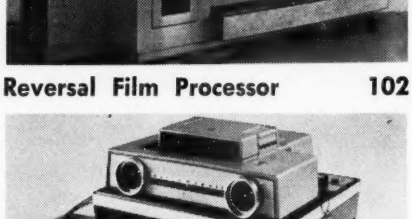
Also in the field of motion pictures we were treated to a showing of the Videotronic 8 projector, an 8mm repeater introduced by MPO Videotronics and described further on. This machine which follows Fairchild was also joined in the sales projector field by the Vicom Mark II, a late entry, which will be discussed next month.

Natural Lighting Corp. never seems to sit still; advanced designs and improvements keep pouring out of their California plant. Note their unit featuring a split load input.

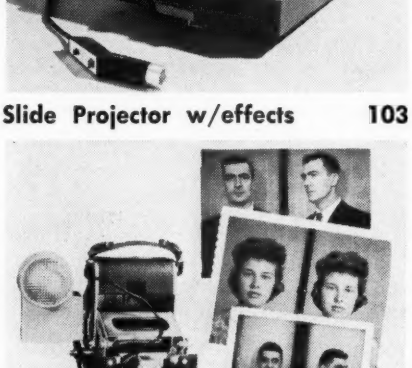


Portable Flood 101

Reversal Film Processor 102



Slide Projector w/effects 103



Multi-Format I.D. Camera 104

High Speed Stereo Camera 106

Portable Flood 101

The high intensity Halogen Lamp introduced by *Sylvania Electric Products, Inc.* and known as the "Sun Gun" has been given even greater versatility with the addition of its own electrical power supply. The unit produces 20,000 center-beam candle-power which is said to be sufficient for still or motion picture photography in color or black and white and operates from a special nickel cadmium battery pack. One big advantage of the new unit is that the light output of the lamp is maintained at a constant level and color temperature is even throughout its 15 hour life. The power pack which was developed by Jim Frezzolini weighs only 16.9 pounds and can be carried on the shoulder with a sling strap. Each charge of the batteries is good for about 32 minutes of constant operation and can be quick-charged again in a few hours by merely connecting to ordinary household electric current. The price of the "Sun Gun" with powerpack will be about $400.

Film Processor 102

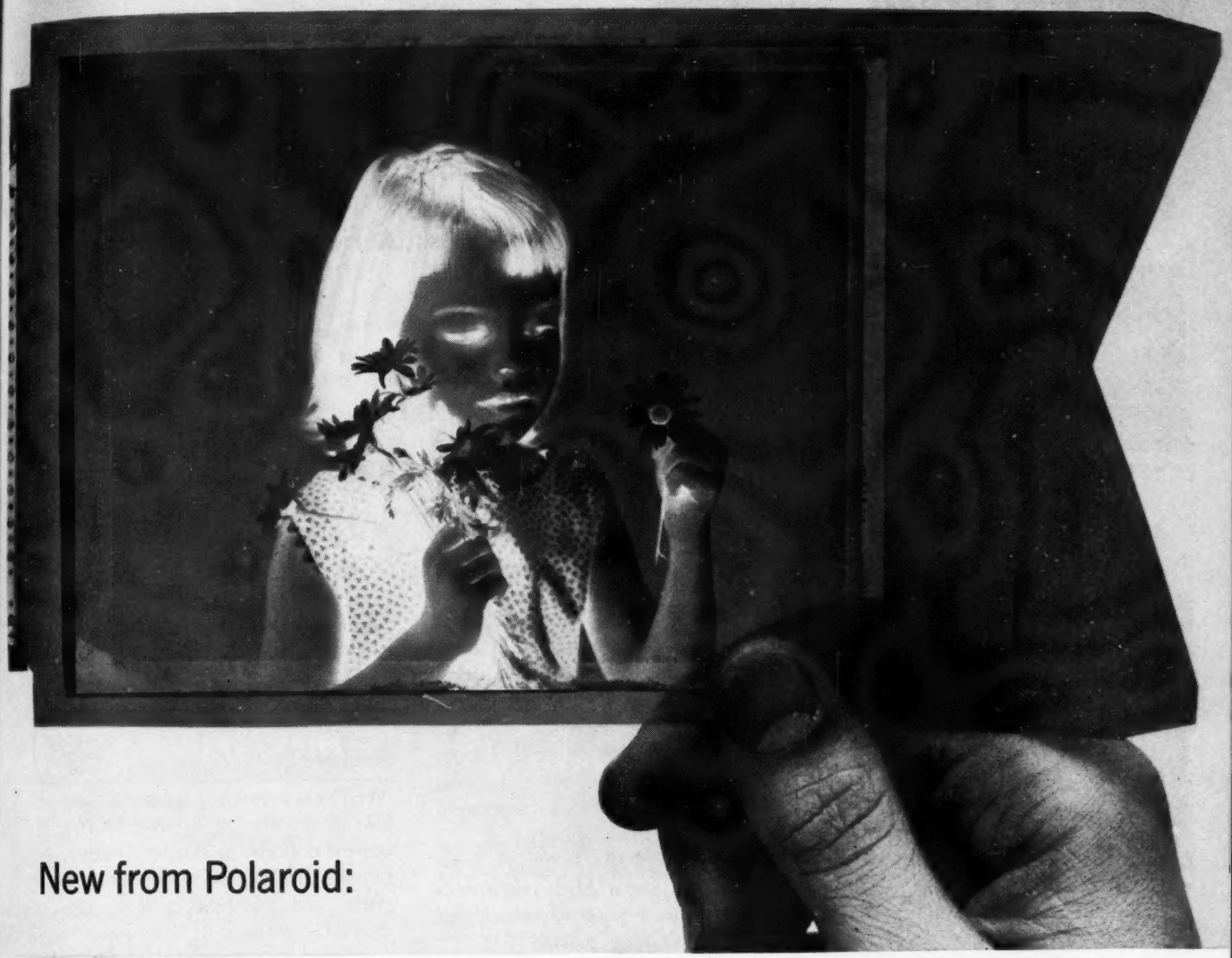
Increased speed and quality are said to be the outstanding features of the R-36 reversal film processor announced by the *Filmline Corp.* The 16mm machine has an Overdrive Film Transport System that is said to eliminate completely film breakage and automatically compensate for stretch. Controlled Automated Processing leaves personnel free to attend to other tasks. Processing times are 2,160 feet per hour and the machine may be daylight loaded through magazines. Other features include variable speed drive, temperature control within a ½ degree of set point, two developer pumps, and a film speed tachometer. At temperatures of 83 degrees the R-36 can also turn out film at better then 60 f.p.m.

Slide Projector 103

A neatly designed solution for those who wish to set up smooth flowing visual presentations is represented by the Tandem-Matic Professional Projector just introduced by *Bell & Howell.* In the past, various efforts have been made to provide lap dissolve effects during slide presentations. Some have been only partially successful and all generally required additional equipment. Now these effects can be produced in a single standard projector which utilizes a split light path through two separate optical systems. The two 5-inch *f*/3.5 lenses are focused on the same spot on the screen and both use light from a single 750-watt lamp. The fade-in, fade-out effect is achieved by means of synchronized blades which gradually close the diamond-shaped iris of one lens while opening that of the other. The whole operation takes 1½ seconds. Slides are loaded in a special Tandem Tray which has a capacity of 54 and is inserted into the rear of the machine. All types of mounts and sizes from 35mm to super slides can be accepted. A remote control mounted in a pistol-grip is also provided on a 12 foot cord which permits the start of the lap dissolve and also its stop at any point for special double exposure effects, reversing the sequence and focus. The tip is also provided with a special pointer light.

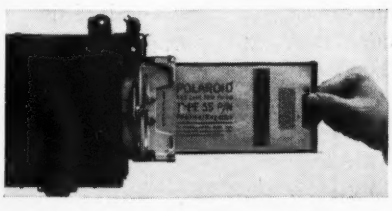
continued on page 79

POLAROID®



New from Polaroid:

A NEGATIVE IN 20 SECONDS



Now, a further advance in 4 x 5 picture-in-an-instant photography: new Polaroid Land Type 55 P/N film pack develops both print and negative. In just 20 seconds. Outside the darkroom.

Simply load Type 55 P/N film into your Polaroid 4 x 5 Film Holder (fits all press and view cameras with Graphic, Graflok and similar backs) and shoot as usual.

Negatives are superb in quality, with resolution in range of 150 lines per mm. Enlargements possible up to 25 times original size with virtually no grain. Positive prints meet professional standards for contrast, fine grain, long scale.

Pack after pack can be inserted and exposed without removing holder. Development takes place inside the pack, outside the holder. Positive and negative can be separated in light. Easy washing process (in room light) rinses fully-developed negative.

Both print and negative developed in 20 seconds: new versatility, new opportunity for the 4 x 5 photographer.

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industrial movie clinic

walter strenge, asc

Got A Problem? Ask A Hollywood Expert

Q. How can I photograph 16mm color frames and 2 x 2 color slides so that I can use them as backgrounds for titles?

A. First photograph titles as white letters on solid black background. Wind back film to starting point. Project 16mm frames or 2 x 2 color slides onto an 11 x 14-inch sheet of .0012 inch thick matte acetate. Position camera on opposite side of screen, focus and frame carefully, and double expose previously filmed title footage. Extension tubes may also be used on the lens and the 16mm frames or color slides filmed directly over a light box. Any focal length lens used at twice its focal length (double extension) will film the 16mm frame actual size. Be sure to allow for effective f/stop, which in this case would be two additional stops increase over exposure reading of light box.

Q. How is the exposure time calculated for a high speed motion picture camera equipped with a rotating prism?

A. Each high speed motion picture camera has an exposure cycle which varies between ⅓ and 1/10 the reciprocal of the picture-taking rate. The actual shutter speed becomes a factor related directly to the open time of the prism/aperture combination, as compared to the time interval between frames. At 1,000 pictures per second, for instance, the exposure time will vary from 1/3,000 to 1/10,000 sec., depending upon the combination of the cut off area of the prism corners and the height of the aperture plate. It is only necessary to know what the exposure cycle fraction is in order to calculate the exposure time. A Fastax with a full or normal aperture plate exposes the film for a period of time equal to ⅓ of the total time necessary to advance the next frame. At 1,000 pictures per second the effective shutter speed would be:

$$\frac{1}{3} \times \frac{1}{1{,}000} = 1/3{,}000 \text{ sec.}$$

If the aperture plate is reduced to .030 inches the factor is 1/10, so the effective shutter speed would be:

$$\frac{1}{10} \times \frac{1}{1{,}000} = 1/10{,}000 \text{ sec.}$$

Exposure calculations may be simplified by dividing the prism/aperture factor into the ASA Exposure Index and reading the exposure directly as a reciprocal of the frame rate. At 1,000 pictures per second, a normal aperture and ASA 125, it would be simpler to divide 125 by ⅓ (or 3) and use ASA 40 as the Exposure Index. The correct f/stop may now be read opposite 1/1000 sec. If the .030 inch aperture were used, the prism/aperture factor would be 1/10 (or 10) which would result in an ASA Exposure Index of 12. This method allows using a standard exposure meter and direct readings without further calculations.

Need movie-making advice? Your film questions are invited by IP's *newest columnist, Walter Strenge, famed Hollywood cinematographer. All questions will be answered and those of wide interest reprinted in* IP. *Address your questions to: Walter Strenge, A.S.C., P.O. Box 985, Hollywood 28, California.*

Q. Has the introduction of faster black-and-white and color

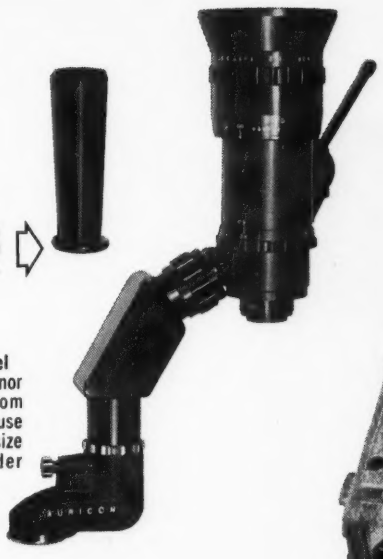
continued on page 75

Auricon, Zoomiscope, Super-1200, Pro-600 Special, and Cine-Voice, are Trade-Marks of Bach Auricon, Inc.

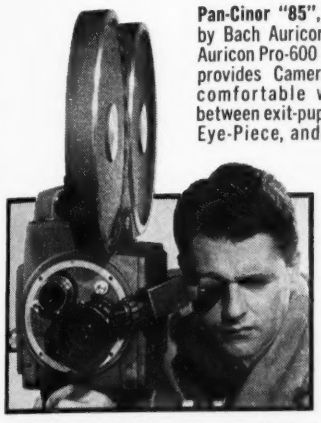
Pan-Cinor "85" and "85 S-EK" are trade-marks of Société D'Optique et De Mécanique De Haute Précision, Paris-20, France.

Regular Pan-Cinor "85" Eye-Piece is unscrewed, and Auricon Zoomiscope Model 85 used instead.

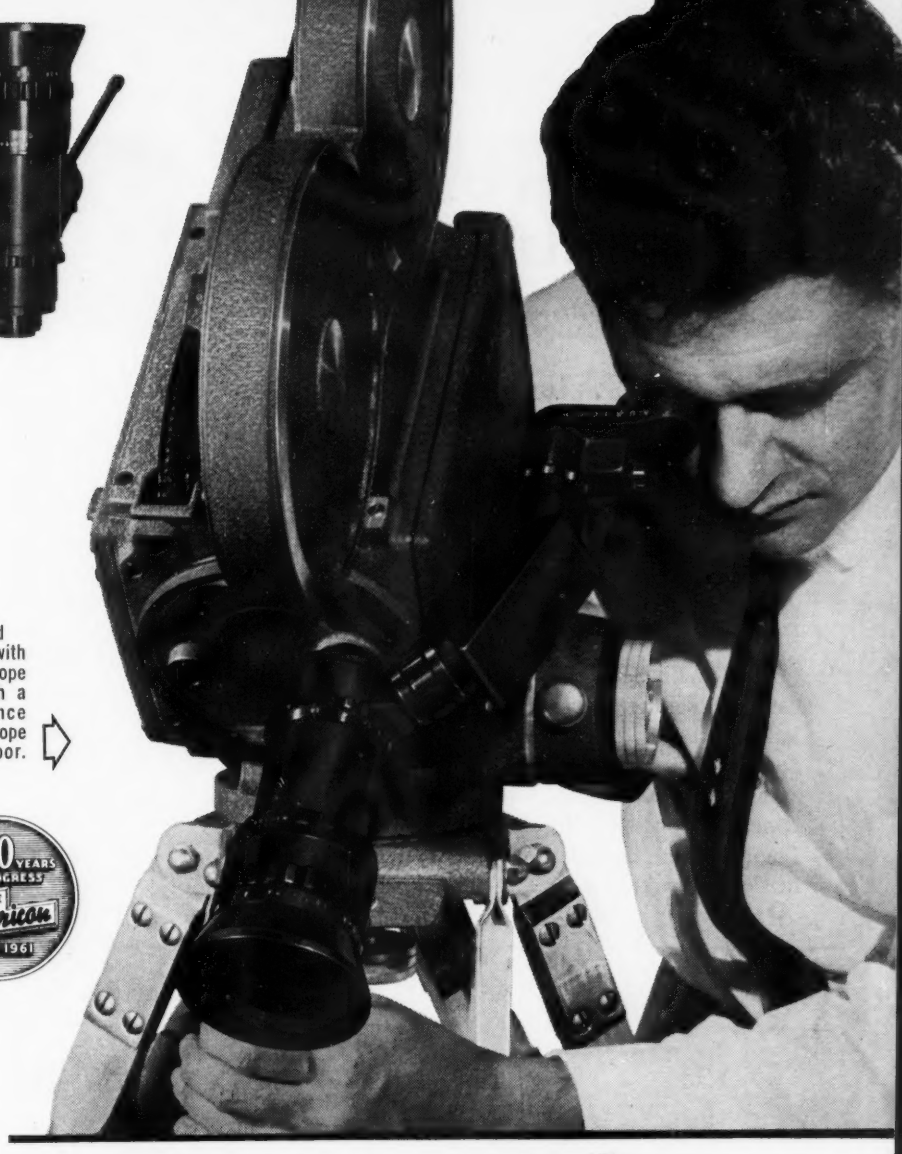
Auricon Zoomiscope Model 85, screws onto Pan-Cinor "85" or "85 S-EK" Zoom Lens (only) without the use of tools; you see same-size image and range-finder as regular "straight-back" Pan-Cinor Eye-Piece.



Pan-Cinor "85", custom-modified by Bach Auricon, Inc. for use with Auricon Pro-600 Special. Zoomiscope provides Camera Operator with a comfortable working distance between exit-pupil of the Zoomiscope Eye-Piece, and the Camera Door.



Pan-Cinor "85 S-EK", custom modified at extra charge by Bach Auricon, Inc. to fit the Auricon Super-1200 Camera, with Zoomiscope Model 85 in use.



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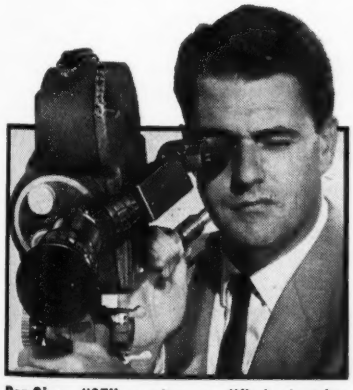


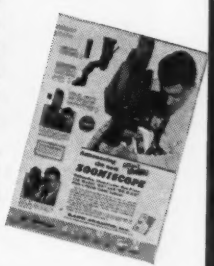
Pan-Cinor "85", custom modified at extra charge by Bach Auricon, Inc., to fit the Auricon Cine-Voice Camera, with Zoomiscope Model 85 in use.

Announcing the new BACH Auricon ZOOMISCOPE

Extension View-finder Eye-Piece for Model "85" and "85 S-EK" PAN-CINOR Zoom Lenses

The Auricon Zoomiscope Model 85 for the Pan-Cinor "85" Zoom Lens provides eye-relief by moving the Camera Operator's eye-position almost two inches away from the side-door of the Auricon camera, while using the Pan-Cinor "85" Zoom Lens. Mounts (without the use of tools) on any Pan-Cinor "85" or "85 S-EK" Zoom Lens View-finder, in place of the regular Pan-Cinor "straight-back" Eye-Piece. Auricon Zoomiscope list price $97.40 for Model 85.

Write for free illustrated information on the Auricon Zoomiscope and details covering custom-modification of Pan-Cinor Model "85" and "85 S-EK" to fit your Auricon camera. Write to...



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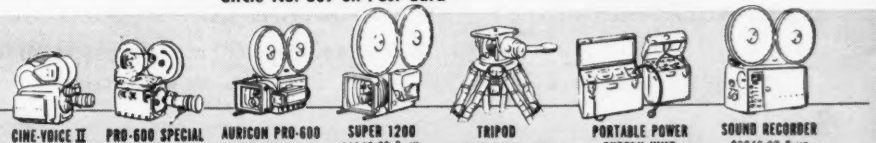

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industrial roundtable

morris gordon, western electric

Turnabout Is Fair Play

For a couple of years now my good friend Jim Hughes and I have been working together as an editorial team. I wrote the copy, and he rode herd on it. For this month, we've turned the tables. I've "loaned" him my column for a discussion of slide-making at the Massachusetts Institute of Technology, and he let me stick in the commas. — Morris Gordon.

M.I.T.'s Lincoln Laboratory even has slide-making down to a science! It has gathered from many sources, but mostly from the American Standards Association and the American Society of Mechanical Engineers, the best available information on making and using slides, added some of its own ideas and come up with standards that have made Lincoln slides masterpieces of visual communication. Gordon Holland of the Design-Engineering Department did most of the work on this project and passes along the following advice to other slide-makers.

Keep Them Simple

A slide should present *one* idea. There should be no more than 20 words on a slide and 15 is preferable. With tabulations, exceptions can be made. Twenty-five or 30 bits of data may be used, but this

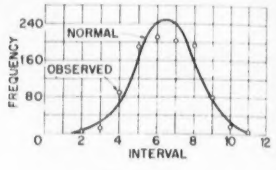

Figure 1

is the limit. Too much detail is usually illegible and cannot be absorbed in the short time the slide is projected.

Letters should be spaced somewhat further apart than for an engineering drawing of the same size. Spacing between lines should be at least equal to the height of the character. Originals should be at least twice the size of the final slide

continued on page 94

The Buttons give you

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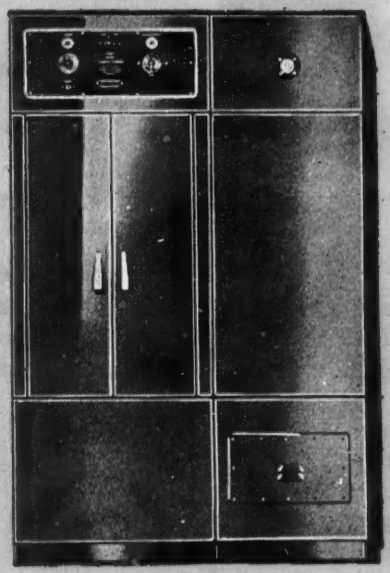
ANHYDRATOR...



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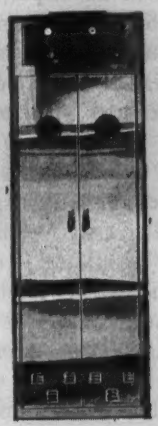

UNIVERSAL

TABLE TOP

Here are three good reasons why film processing need not depend on the weather for favorable drying conditions. The cleanest, dryest climate imaginable is contained in these space saving packages of film drying efficiency.

The FISHER ANHYDRATOR (at top) is known all over the world for its ability to dry film without heat in less than ten minutes. These units lock out weather to dry films (from 4 X 5 to 48 X 60 in.) to the most rigid dimensional requirements and is available in four standard or custom-built models of varied capacities.

The Universal All Film Dryer (at left) dries a film load of 14,000 sq. inches in 15 minutes. Operating on a supply of filtered air and calrod type heat, the dryer is economic and efficient. Accepts (60) 14" X 17" X-Ray films or (24) 20" X 24" graphic arts films, (60) rolls of 120 film (140) sheets of 4 X 5 in., 5 X 7 in., or 8 X 10 in. film. Accepts all sizes of film from 8 mm (Minox). Dryer requires only 28½" X 20" of floor space and is 82" in height.

The Fisher table top model (at right) is a tried and proven unit for use where small capacity yet fast, efficient drying is required. This unit requires only 11" X 18" of table space and is 36 inches high. Accepts (24) 4 X 5 in., (24) 5 X 7 in., (12) 8 X 10 in., (6) 14 X 17 in. or (6) 12 X 20 in. sheet films. Comes complete with one set of standard cut film racks . . . roll film racks available. For complete information on Fisher dryers write . . .

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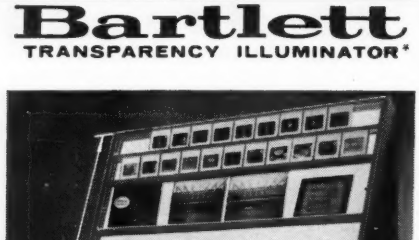
TRANSPARENCY ILLUMINATOR*



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11 MOVEABLE CHANNELS rest on pins for quick, easy re-arrangement. Channels and frame are of anodized aluminum. Even illumination • Color correct • Cool operating. Hang it on the wall, use it on a table.

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a-v workshop

james hughes, executive editor

M.I.T. Likes 3¼ x 4's

The 3¼ x 4 black-and-white lantern slide is the backbone visual aid in the classrooms of the Massachusetts Institute of Technology. Between 12,000 and 15,000 are produced each year by M.I.T.'s Photographic Service for use by lecturers.

Two-inch by two-inch slides are also used but usually only when color is required. They represent about 10 per cent of the Photographic Service's annual slide production. Where duplicates of color slides are needed, they are ordered from an outside service.

The reason for the popularity of slides at M.I.T. is their flexibility. With them an instructor can vary or update his program, something he cannot do readily with filmstrips or motion pictures.

The reason for the popularity of the 3¼ x 4 size is history. As with so many other things, M.I.T. was a leader in the use of educational visual aids. They equipped classrooms with standard lantern slide projectors when the 3¼ x 4 size was the only size. Through the years thousands and thousands of slides this size have been produced by and placed on file all over the Institute. They have proven adequate to their task, so it would be an unwarranted expense at this time to switch over completely to the 2 x 2 format. Therefore, to keep slide programs compatible, most new slides continue to be made 3¼ x 4.

The copy for M.I.T. slides is extremely varied in subject matter and comes from numerous sources. A slide may be made from a continuous tone picture out of a book or one from the camera of an M.I.T. photographer; it may be made from a line drawing prepared by a draftsman or a fine artist; it may be made from copy prepared by the originating department, or the university's illustrative or publications service; it may be made from a tabulation of data put together in the form of a table or a graph.

Frank Conant, manager of the Photographic Service, never stops looking for new ways of improving his products or reducing their cost. Towards that end, he recently had installed in his department's Illustrative Studio a 35mm microreproduction camera to turn out quantities of negatives for both size slides and is currently refining a new slide-making technique. When I was in Cambridge, gathering material for this special M.I.T. issue, he described both the old and the new techniques to me:

"Previously, to produce a standard lantern slide, a cameraman would load a conventional 3¼"x4" size cut film holder with a sheet of cut film. After focusing the copy image on the ground glass of a 4 x 5 camera, he would insert the holder and make his exposure. He would then remove the film in a darkroom and develop it with hangers through the processing tanks. After drying the film, he would proceed to expose the image by contact in a specially built contact printer onto sensitized lantern slide glass plates. Finally, the slides would have to be masked, cleaned and bound before delivery.

"These steps at today's labor and material costs were beginning to put too high a price on finished lantern slides. We had no quarrel with the quality, and we were able to maintain a good service schedule, but the cost was getting out of hand.

continued on page 72

notes from the reproduction manager...

hal denstman, lockheed electronics co.

Automatic Block-Outs on Continuous Tone Copies

At one time or another most reproduction technicians have been presented with the problem of copying continuous tone paste-ups, silhouette images (photographic prints with the background removed) and combinations of line copy and tone images. The problem becomes evident when the films are checked on a light table. In most cases, the images are reproduced faithfully but the background does not have enough density to drop out on the final photographic prints.

In addition to a low density background, the negative has also recorded all of the paste-up marks, guide lines and handling marks that may have been on the original. The inability of conventional photographic films to hold whites in the background areas leaves the reproduction technician with two alternatives: 1) Opaque the copy negative. 2) Make two exposures on the original, one on a continuous tone film and one on a lithographic film, with the image of the original masked with red acetate.

Time Varies

Opaquing the copy negative may require only a few minutes for simple subject matter, but considerable opaquing time for more complex views. The second alternative involves considerably more time and skill, both in making the overlay mask and in the final registration of the two negatives.

There is, however, a simple solution which can reduce the effort on difficult copy assignments, and at the same time produce excellent results. The solution is to use the Gevaert Type II Correctone film.

Correctone is a sheet film made up of two separate emulsion layers — a continuous tone or long scale emulsion which is positioned underneath the high contrast emulsion. With proper handling this material is capable of increasing highlights and even dropping out the background area on difficult originals.

Correctone film was specifically designed for reproducing originals requiring "block-outs", and highlight increases. Artwork, exploded views, wash drawings, and combinations of line and tone can be handled with ease. Correctone can be used in two ways:

1 As a dual exposure system which requires filtering each layer separately.
2 As a single exposure system utilizing variations in exposure and development.

This column will deal only with the dual exposure system, the single exposure system being discussed at a later date.

Since the long scale emulsion has a high blue sensitivity, similar to commercial type film, the light source should be high in blue. Carbon arc is recommended and will produce the shortest exposure times. Dalite fluorescents can be used, as well as ColorTran lights and tungsten bulbs.

If possible, arc lamps should be employed, although good results are possible from the other types of lighting already mentioned. Two carbon arcs positioned approximately four feet from the original will require from three to six seconds exposure for a one-to-one copy at *f*/45. Tungsten bulbs can be used at an ASA index of 1.5. All tests should be made at a one-to-one ratio for determining basic exposure times.

With the dual exposure system two filters must be employed — one

continued on page 74

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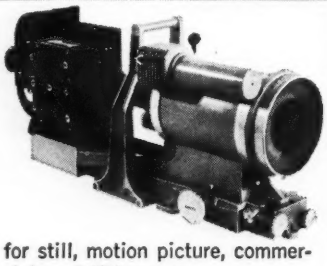

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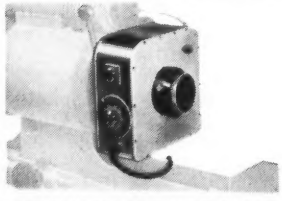

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european newsletter

michael j. langford

Fundamental Values

Contemporary in-plant photography is little more than a continuous obstacle race. As we gallop around the track obstacles and brickbats thrown by spectators assail us on all sides. The production of a successful photograph is only achieved by navigating such hurdles as the time factor, poor subject condition, cramped working conditions, non-co-operative personnel, technical photographic limitations and the apathy and conservatism of management. Under the circumstances it seems a miracle that anything is produced at all — and the chances of original, creative interpretation appear even more remote.

On one hand it is tempting to suggest that these difficulties excuse any attempt to aim at ideals. It's always less effort to sit and await orders than to educate industry on the creative possibilities of photography. Here we come up against individual interpretation of this word 'photography'. Certain photographers are satisfied to see photography as a chemical notebook calling for the completion of a set procedure, and their jobs as payment for a certain expenditure of energy. Others see in photography a means of individual expression capable of infinite variation and never fully learnt.

While in Germany recently I discussed this variance of outlook with a forthright exponent of the latter school of thought, Fritz Brill. Far from being a long-haired penniless idealist, Brill — as one of Europe's top industrial photographers — has proved that his philosophy pays. Briefly this centers on getting down to fundamentals and coming to terms with things in their own right. As adults we're far too inhibited about what we see in front of the camera — far too willing to pigeon-hole things or copy the ways of others.

Take a practical example. A photographer has the regular task of illustrating rivets for brochures and prestige advertising. They vary in size, shape and material, but his technique is largely standard — a continuous background, soft, maximum information lighting. He does it this way because (having for many years seen such pictures in print) management has been conditioned to accept it.

This does not mean to say that it is the only or best way to portray rivets, or that in time executives could not be conditioned to something more exclusive to their product via their photographer's original thinking. The trouble is that the years have taken their toll, and by now the photographer is so inhibited that when handed these pieces of metal he sees them only as rivets — and his mind automatically produces the 'standard rivet-photographing procedure'.

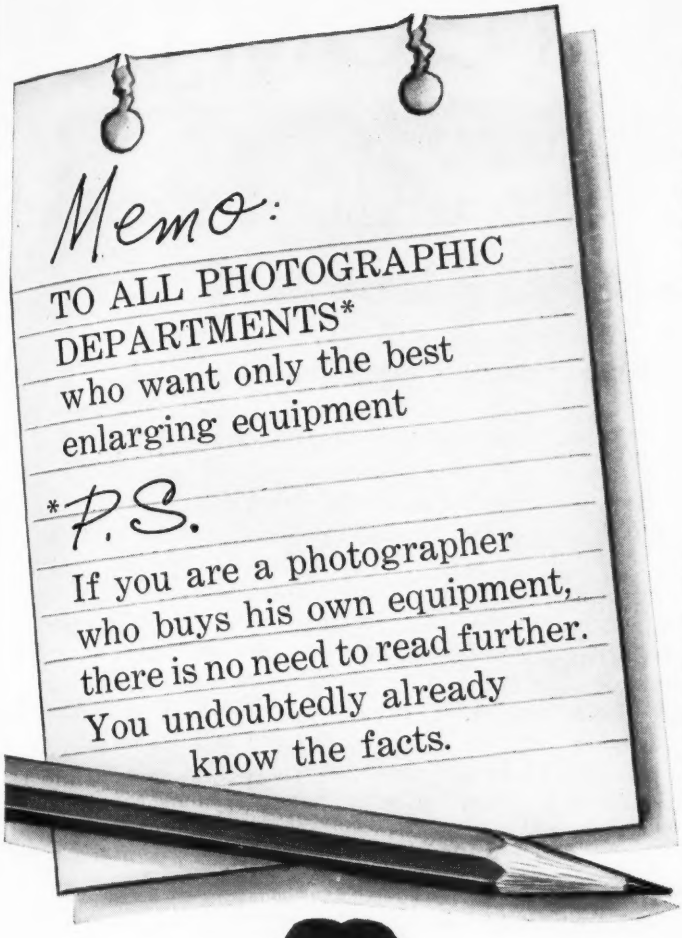
One Way To Do It

One method of subject re-recognition on an individual basis is to take these rivets into a darkroom and attempt to evaluate them by touch. This photographer may be impressed by their smoothness, hardness, light weight, etc. Obviously there may be commercial considerations to bear in mind too — tensile strength, etc.

He now goes on to 'put over' these fundamental impressions by his lighting, composition and general technique. This is what gives his work its own individual stamp — work built on *fundamental objective appraisal* instead of conventionality.

Initially he may find everyone —

continued on page 76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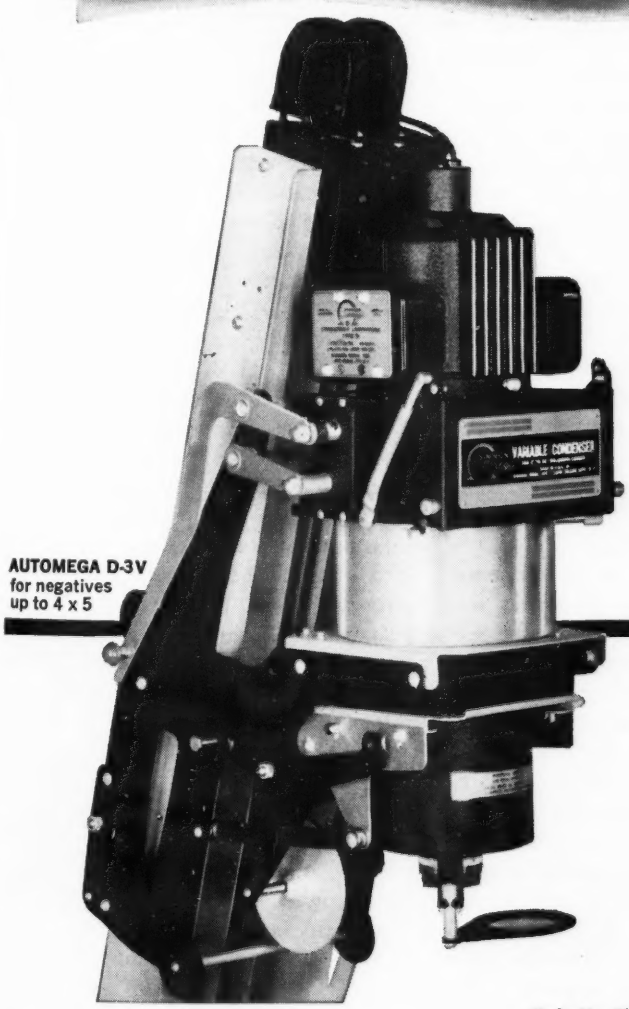

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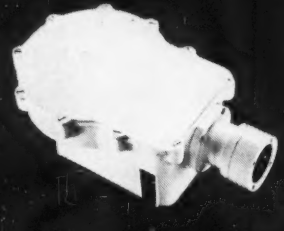

The "Project Bigshot," Echo A-12 will utilize the new 400 ft. capacity DBM 10 camera for surveillance and measurements during the inflation of the communications satellite balloon (satelloon) in space.

The camera contains the basic Milliken movement, further proving its adaptability to specific instrumentation requirements.

The DBM 10 will operate at 24 fps with register pin for high definition and picture steadiness. The camera, installed in a recoverable capsule, will sustain an 80 G load and is hermetically sealed for underwater or explosive environments. An output pulse is produced during each exposure for telemetering.

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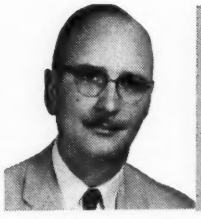

photo-instrumentation

paul lathrop, general electric

Submicrosecond Flash Sources

The theme of this issue of INDUSTRIAL PHOTOGRAPHY is the application of photography at MIT, which ranks among the top scientific institutions of the world. Following through on the issue theme, I think it appropriate to report on two submicrosecond flash sources for photography by reflected light, silhouette and schlieren techniques which have been perfected by three members of MIT's Electrical Engineering Department. The three gentlemen are Dr. Harold Edgerton (whose other activities are described on page 40), John Tredwell and Kenneth W. Cooper Jr. Their research has been concerned with finding light sources that meet present day demands. These are:

(1) A light source with a flash duration of 1 μsec. or less for reflected-light photography.

(2) A light source of *small dimensions* for *shadow* (silhouette) photography. The duration should be in the 0.1-1-μsec. range. Film should be exposed to the source at a distance of about 4 ft.

(3) A small light source of very short duration, 0.01-0.1μ sec., for photographing small high-speed subjects using an efficient backlighted optical system.

How They Did It

In the words of the MIT team, here is how they fulfilled these requirements:

"After considerable experimentation, a "guided" air spark was selected as a practical source for reflected-light photography. Xenon and argon were rejected since, at the time duration desired, the afterglow of light lasted too long.

"The gap of the "guided" air-arc source is about an inch long on the outside of a 7mm-OD Pyrex glass tube. Starting is facilitated if the electrodes are adjacent to and in contact with the tube walls since starting is definitely a surface phenomenon. The 18 kv applied to the electrodes is insufficient to cause an arc to start; however, if a high voltage is suddenly impressed on the *inside* of the tube, conduction starts very quickly. Air at atmospheric pressure is used as a gas since the afterglow of light following the flash is of short time duration and of a red color.

Two Series Capacitors Used

"The lamp is excited by two series capacitors totaling 0.05 μf charged to 18 kv, which store about 8 watt-sec. of electrical energy. The efficiency is about 0.25 horizontal candlepower per watt. Every effort must be made to keep the inductive wire loops in the discharge circuit to a minimum if the flash is to be of short duration.

"A 7/8-in.-OD glass tube is used to insulate the high voltage from the reflector and also to reduce the noise from the spark. Also, rubber is used at the open end of the outside tube to reduce the noise of the spark.

"For bullet photography, the light output should be concentrated into a narrow beam so that an intense spot can be aimed at the event. The assembly can be mounted into a box for practical use. Here a specular reflector produces a spot of about 10-in. diameter at a distance of 3 ft. from the lamp. An aperture of $f/8$ is suitable with Panatomic-X film, especially if a light background can be used to outline the dark portions of the bullet, and if prolonged development is employed.

"Triggering of the light at the

continued on page 77

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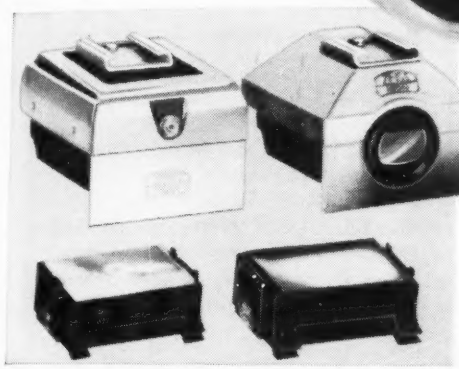

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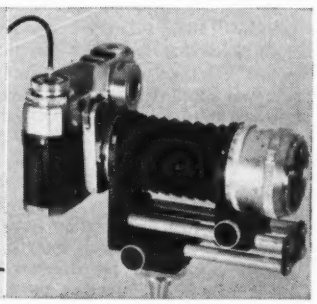

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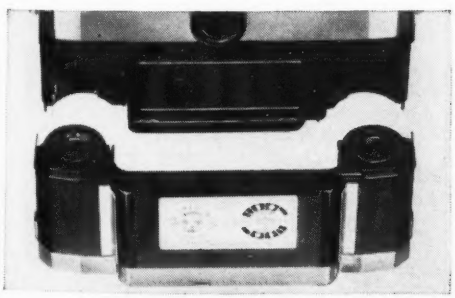

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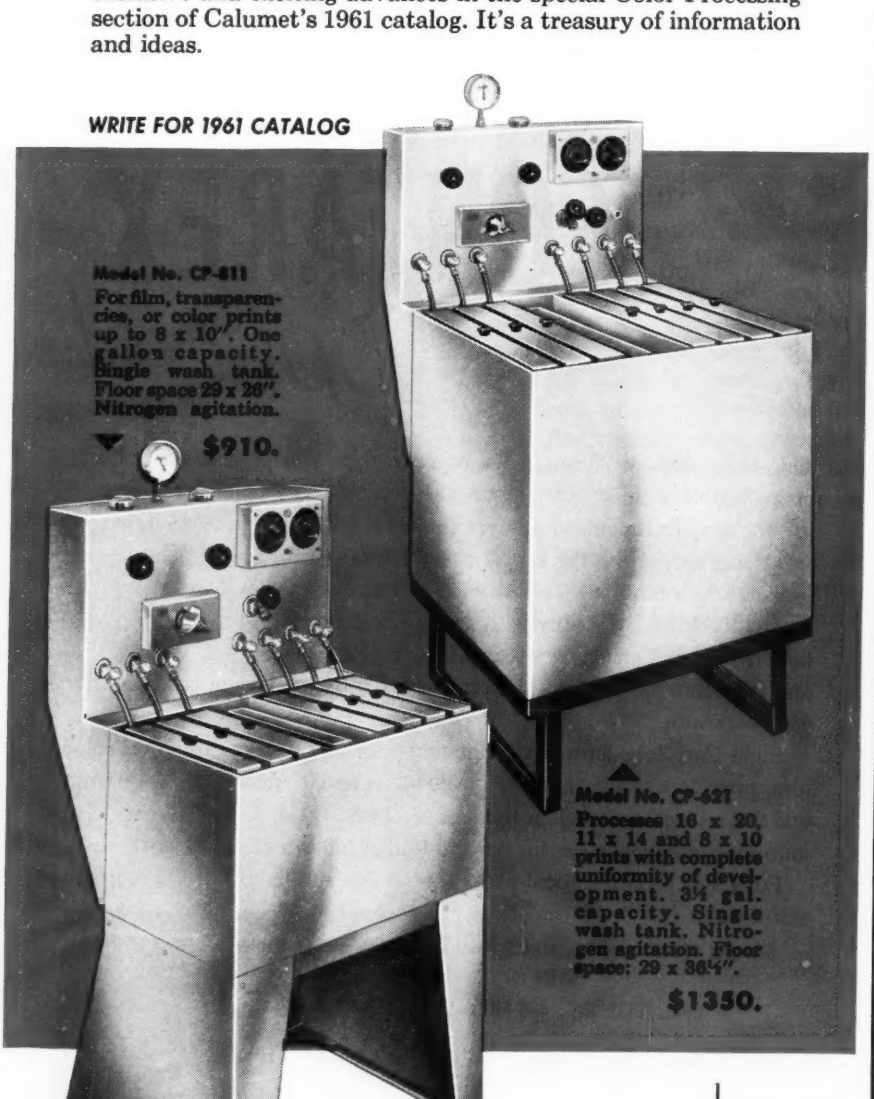
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IP CALENDAR

Nov. 1-14 . . . San Francisco International Film Festival, Metro Theatre.

Nov. 8-10 . . . 8mm Sound Film and Education conference, Teachers College, Columbia University, N.Y.C.

Nov. 9-20 . . . Third Biennale Internationale Photo-Cinema-Optique, Grand Palais, Paris.

Nov. 9 . . . Industrial Photographers Association of America monthly meeting. FR will demonstrate their new color printing process. Essex House, Newark, N. J.

Nov. 11 . . . Mid-States Industrial Photographers Association all-day program, YMCA, LaGrange, Ill., 9 A.M. Subjects to include in-plant movies, macrophotography, etc.

Nov. 14-16 . . . Instrumentation seminar sponsored by Photographic Analysis Company, Clifton, N. J.

Dec. 2-5 . . . SRE Visual Communications Congress, Biltmore Hotel, Los Angeles.

Dec. 5-7 . . . Institute of British Photographers Industrial Photographers Conference, London.

Regular Meetings

Rochester chapter, SPSE, meets on the second thursday of each month . . . Industry Film Producers Association, *Los Angeles chapter,* meets the first wednesday of each month . . . Southern California Industrial Photographers gather every third tuesday . . . Industrial Photographers of America *(N.Y.-N.J.)* meet the second and fourth thursday . . . Rocky Mountain Industrial Photographers gather every fourth monday in Denver . . . National Visual Presentation Association convenes every second thursday in New York . . . *New York chapters,* SPSE, SPIE, SMPTE and SRE meet on the first wednesday, third thursday, second wednesday and third monday respectively . . . *Binghamton chapter,* SPSE comes together every third thursday, while S. California SPSE meets last monday and Cleveland SPSE meets first tuesday . . . Association of Federal Photographers (Washington, D.C.) has meetings every third wednesday . . . *S. California* and *N. California* Biological Photographic Associations meet respectively on the third thursday and fourth friday of the month . . . *Chicago branch* of the same group has meetings every third tuesday . . . Minnesota Industrial Photographers Assn. holds meetings the first thursday of each month. . . . Industrial Photographers Association of America *(N.Y.-N.J.)* gathers on second thursdays.

To get information on any group listed above, or to get your society listed, drop a note to IP CALENDAR, c/o *Industrial Photography,* 10 E. 40 St., N.Y. 16, N.Y.

shop talk

IF THE SCIENTISTS AT EASTMAN KODAK have their way we may someday soon see a motion picture projector that chloroforms the film it projects. Although there are many movies around that could stand such treatment (and interment, too), the E-K scientists are referring to a liquid gate concept that would improve quality and eliminate film scratches. In a paper delivered at the recent convention of the Society of Motion Picture and Television Engineers, an E-K team described a system consisting of two glass plates. The frame being projected is held in sharp focus between these by a thick layer of methyl chloroform. Air knives and a vacuum squeegee remove liquid from the film as it leaves the gate. A recirculating system carries the methyl chloroform back to the film gate for reuse. The new method is said to cool and position the film, relieve the harmful side effects of high-intensity projection and give a sharper image.

SOME FIGURES RELEASED BY THE PROFESSIONAL PHOTOGRAPHERS OF AMERICA back up the remarkable growth of our industrial photographic industry. Speaking before the American Public Works Association, Fred Quellmalz, executive manager, PPofA, stated that two-thirds of all photographic materials manufactured today are used in business, industry, government and science. He further noted that the graphic arts, based solely on photography, have grown into a new billion-dollar-a-year industry.

VISUAL REPRODUCTION TECHNOLOGY is going rapidly ahead. Ferris Institute, Big Rapids, Mich., a college specializing in training reproduction technicians, has expanded its facilities and faculty. Supervising the expanded program are Lyle Udall and Richard Hertz, both experienced photo-reproduction men. Udall comes from the Superior Coach Co. where he was industrial photographic supervisor.

POLICE SERGEANT RON PERKINS, seen at the right, is an industrial photographer! He is a member of the Culver City (Calif.) Police Department which is branching out into the movie-making business, but strictly on a law enforcement basis. Sgt. Perkins' "actors" are suspected law breakers, chiefly drunk drivers and dope addicts. By taking movies the Department is able to record both visual and audible evidence of the accused's condition at the time of arrest, in the field or station house. When the movies are taken with a 16mm Bolex, the suspect is given notice by a large sign which reads "You are notified that motion pictures are now being taken of you." A portable Nomad Mark I magnetic recorder operates while the films are shot so that a perfectly-synchronized sound track is also obtained. These unique "in-plant" movies have had two immediate results for the Culver City Police, a large decrease in the number of cases going to trial and a reduction in costs. Faced with proof-positive on film, more suspects now plead guilty without requesting a trial. The cost of the sound film, including processing, is only $8.50 per suspect as compared to $20 for chemical blood analyses.

HAVE YOU EVER WONDERED WHY an outside photographer is called in to make a special shot, bypassing the in-plant photographer who labors faithfully day-after-day on the routine shots? Fritz Henle, one of the leading free-lance photographers, gets many industrial assignments and offers some thoughts on this subject in **Popular Photography** magazine. "Very often it comes down to the fact that my shots are better organized, that people are in more meaningful relation to their tools and surroundings; in effect, my composition is better. I am never conscious of this as I shoot but I did have early training in the subject (art and composition) and am aware of it when I look at pictures — mine or others. I would urge that every photographer expose himself to some art training. Esthetics can pay off, not only in dollars but satisfaction."

EUROPEAN READERS will be interested to note that the Institute of British Photographers (our English cousins' professional organization equivalent to the PPofA) has announced a three-day conference for industrial and cine photographers to be held at the Central Hall, Westminster, London, Dec. 5-7. Details may be obtained from the IBP, 38 Bedford Square, London, W.C.1, England.

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EDITORIAL

Photography At M.I.T.

We depart from our regular editorial format this month to give you a report in depth on the role of photography at the Massachusetts Institute of Technology.

This departure is not without precedent. Since 1956 we have devoted similar issues to the photographic-reproduction activities of the Ford Motor Company, Bell Aircraft, General Motors, General Electric, Avco and General Mills. This, however, is the first such issue devoted to an educational institution.

But why, you may ask. Why an educational institution? Where does it fit into the industrial photographic picture?

If M.I.T. were an ordinary institution of higher learning, it might not. But M.I.T. is something unique. As perhaps no other institution's, M.I.T.'s interests and influence reach into American business, industry, government and science. Presidents Roosevelt, Eisenhower and Kennedy have all had M.I.T. men as their chief scientific advisers. Tracing the direct and indirect influence of M.I.T. on our society could keep an historian busy a lifetime.

Noting these facts, it becomes evident that acceptance of specific photographic techniques by M.I.T. assures that their utilization will not stop at the banks of the Charles River. And photography is accepted, practiced and honored at the Cambridge school as perhaps at no other in the United States. There are cameras and darkrooms everywhere. And there are talented men – young and old – using them. So extensive is the role of photography at M.I.T. that no effort has been made to make this a comprehensive report. However, starting on page 29, we offer what we hope is a presentation that will at least indicate the impact of two vital forces on one another – M.I.T. and photography. This issue would not have been possible without the wholehearted, active cooperation of people at M.I.T. We thank them all, especially Francis E. Wylie, Director of Public Relations and his able assistant, Miss Robin Watson.

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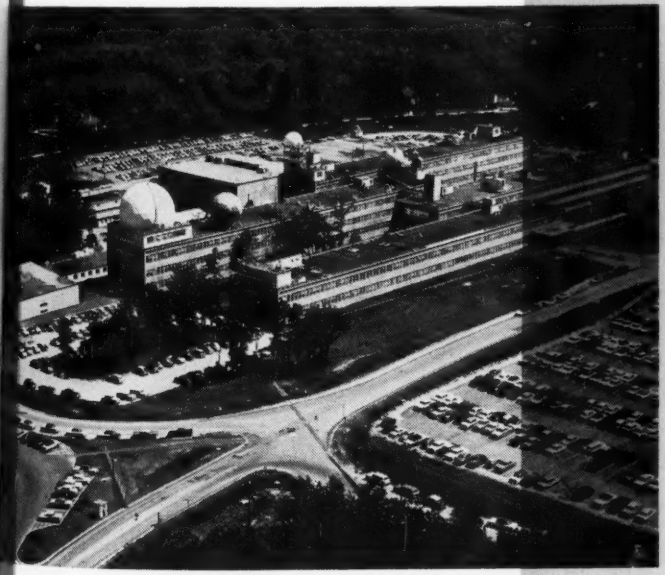
M.I.T. AT 100

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Photography and the Massachusetts Institute of Technology — each has added eminence to the other during the past one hundred years.



M.I.T.'S LINCOLN LABORATORY, which is operated with support from the U.S. Army, Navy and Air Force.

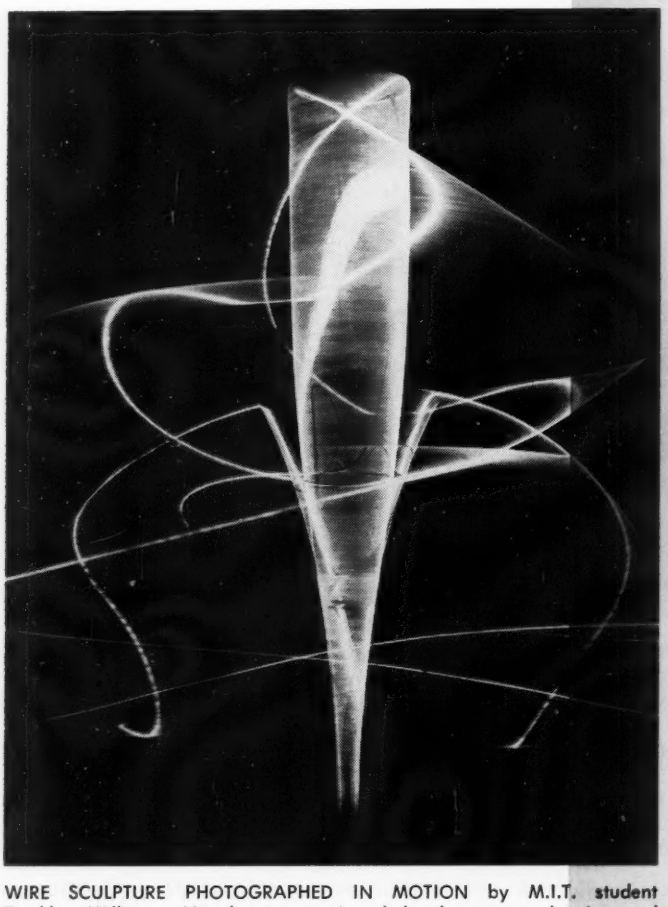
This year the Massachusetts Institute of Technology celebrated its centennial. It is fairly safe to say that in the past 100 years no comparable institution has had as wide nor as profound an effect on the material life of Americans as has had M.I.T. In the words of President John F. Kennedy, "There are few Americans who have not benefited from M.I.T."

The very same 100 years have witnessed the evolution of photography from toy to respected instrument of science. It was only natural, therefore, for photography to become a tool of the Cambridge institution in its quest for knowledge. Each has added eminence to the other.

Polarized around science, M.I.T. has five schools: the Schools of Engineering, Science, Architecture and City Planning, Industrial Management, and Humanities and Social Science. Photography has functions in all. *Example:* The Science Teaching Center is finding new ways of using film material to lead students through complicated experiments; or to allow alternate experiments without wasting teacher time.

Although education is its prime function, M.I.T.

PROF. THEOS J. THOMPSON climbs out of the center of the M.I.T. nuclear reactor. He photographed every inch of the interior before the core was inserted, making a record to show the position of the graphite blocks which line the reactor.



WIRE SCULPTURE PHOTOGRAPHED IN MOTION by M.I.T. student Franklyn Williams. Visual arts exercises help the young chemists and mathematicians to confront the problems of visual communication.

conducts original research in more than 70 laboratories. Photography has roles in most. *Examples:* The Naval Supersonic Laboratory has a wind tunnel in which models of airplanes, missiles and the like are tested for their ability to fend off air at hypersonic speeds without collapsing. A recent development has been the photographing in its true color of the rush of air past the tested object.

For years wind tunnel operators have used schlieren systems for making the air flow in the vicinity of a model placed in a tunnel visible to the naked eye. But at the extremely low pressures and densities associated with hypersonic flow there are not enough air molecules for good schlieren observations. The new M.I.T. technique places two negatively charged probes in the air stream, a trifle closer to the model than to any other part of the tunnel, all of which is a positive electrical ground. As the voltage is increased to around 1,100 volts in these probes, there is a reaction with the excited air in the tunnel and the flow patterns become photographable in strange, brilliant oranges and blues. These photographs make flow phenomena available for study that had been postulated theoretically although never verified experimentally before.

At the Research Laboratory of Electronics, color photographs have been used to show that the relationship between the eye and the brain may not be what had hitherto been assumed — at least as far as a frog is concerned. Prof. Jerome Y. Lettvin and Dr. H. R. Maturana have found that the frog will go into action if he sees a moving object which looks like a fly to him, but he will starve in the midst of plenty of dead flies.

M.I.T. TECHNICIAN removes print of damped sine wave recorded on 10,000-speed Polascope film. Oscillography involving Polaroid rollfilm backs mounted on oscilloscope cameras is commonly practiced in M.I.T. labs.

The researchers found that when they held a color photograph of the frog's natural habitat, complete to flowers, grass and water's edge, in front of a frog, nothing happened. The photograph was moved across his vision, with no response. But when a small black dot was moved across the photograph by a magnet, the frog jumped at it.

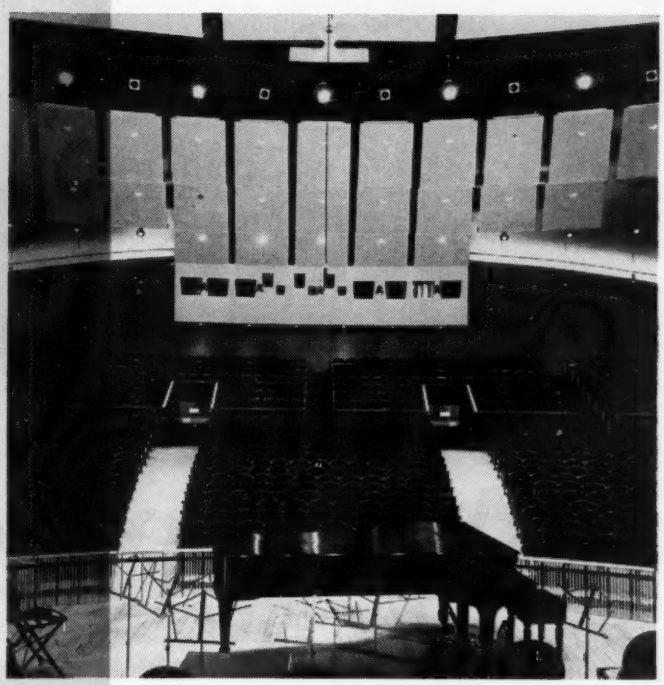
M.I.T. is perpetually in ferment. More than any other university it reflects this age of science.

The Department of Biology is penetrating the innermost secrets of life through photographs of DNA made through an electron microscope. DNA is the most important molecule substance now known. It is the "chemical of heredity," directing the destiny of cells to be formed, telling when and where and in what order the growth of life should proceed. Electron microscope photos made in the laboratory of Prof. Cecil E. Hall have figured importantly in the study of DNA.

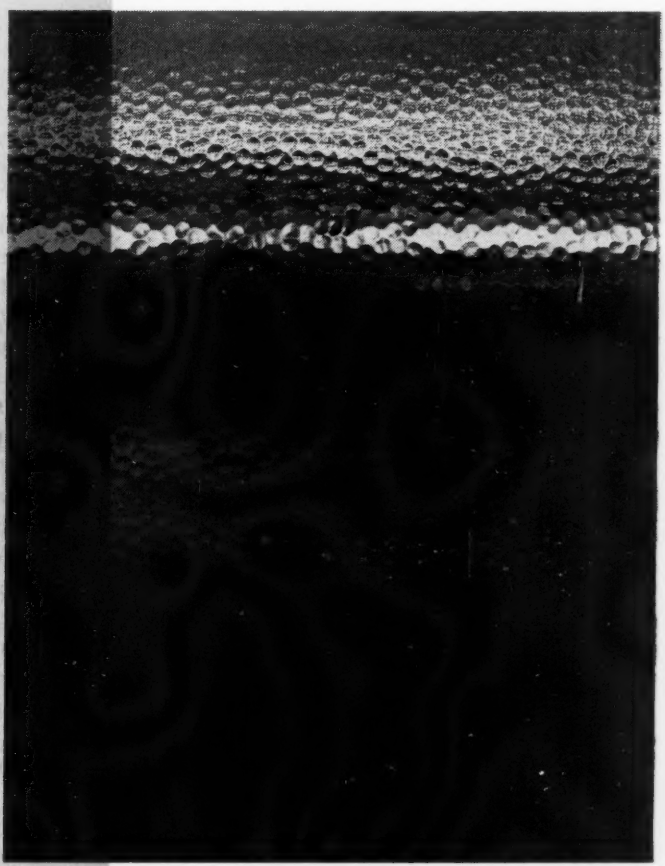
M.I.T. has profited from photography indirectly as well as directly. George Eastman was the first of its millionaire endowers. Dr. Land of Polaroid gives unstintingly of his time and wisdom. . . .

And, of course, photography has profited from M.I.T.: through the discoveries and developments of Dr. Harold E. Edgerton; through the photographic industry being able to draw upon the reservoir of brain power cultivated on the shore of the Charles River. . . .

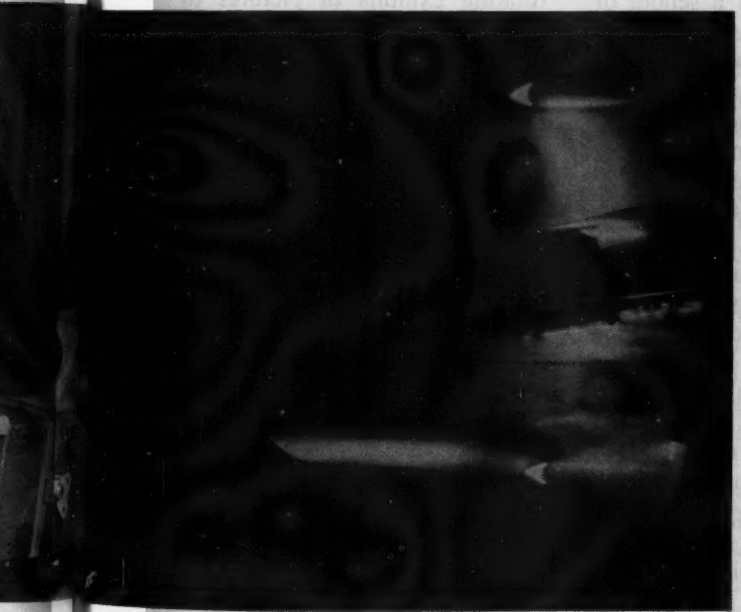
In this article we have been able only to hint at the range and depth of the relationship between M.I.T. and photography; in this issue we have been able only to scratch the surface of it. But we hope that we have succeeded in indicating it. □



KRESGE AUDITORIUM features a large, well-equipped projection booth. M.I.T. houses some of the most exciting projects in the world — and photography is a part of many of them.



TEXTURED GLASS. This photograph is another product of an M.I.T. visual arts course where students develop a critical understanding of art and design.



AIR FLOW recorded in M.I.T. Naval Supersonic Laboratory. Camera: Speed Graphic; Exposure Time: 15 seconds; Lens: f/4.5. Such photographs make flow phenomena available for study.

M.I.T. GRAPHIC ARTS BUILDING. It houses Photographic Service.

A Complete Package

The Photographic Service of the Massachusetts Institute of Technology was organized in 1925 through the efforts of Professor Arthur C. Hardy of the Optics Laboratory and Russell W. Conant of the Physics Department, who felt there was a need for a central photographic service.

They started with one small darkroom and one employee, Conant's brother, Frank. Today, Frank H. Conant manages a service that occupies two floors of a large modern building and employs half a hundred people. Under one roof are not only conventional photographic facilities but a variety of other reproduction facilities as well, including an offset printing plant that is a story in itself (see page 62). Illustration and letter shop services are also available in the red brick Tudor building on Massachusetts Avenue.

"Naturally, we are proud of what we have here," says Conant. "I wouldn't wish to start an argument, but I think it is unique. I have yet to learn of a school or college with quite as complete a package of services, with quite the variety of processes, or one which has seen fit to devote the same space, personnel or equipment to this purpose."

What is now the Graphic Arts Building originally housed the grandfather of all digital computers — M.I.T.'s Whirlwind. When the Photographic Service moved into the remodeled building last year, it was probably the first instance in this day and age of a computer being replaced *by* rather than replacing.

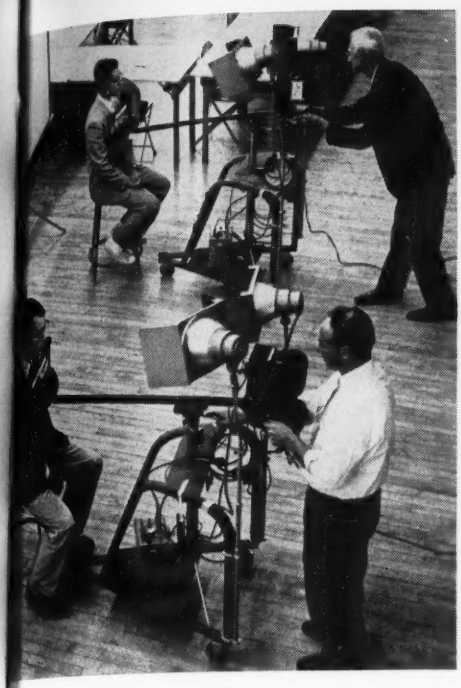
This move represented a dream come true for Frank Conant, who had campaigned vigorously for such an integrated facility. Just before moving into the present plant, the service had occupied scattered available space in six different buildings—not the most efficient arrangement.

At the heart of the photoreproduction facility is a 75-foot by 35-foot area which has been divided into a tastefully decorated reception room, a multi-curtained portrait studio and an illustrative studio for photographing inanimate objects. The whole area can be thrown open for large group pictures.

It is reached by a corridor whose walls are decorated with rotating exhibits of pictures by leading photographers through-

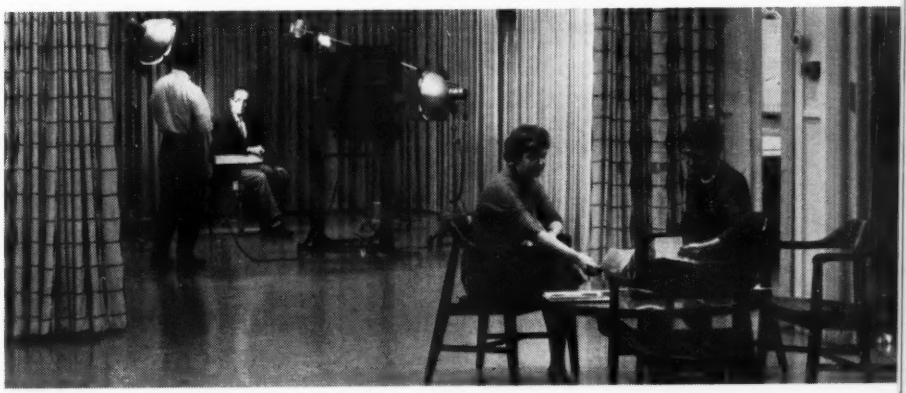
FRANK H. CONANT, Manager of M.I.T.'s Graphic Arts Services and man most responsible for its growth.

DANIEL G. WEBSTER, Assistant Manager, Graphic Arts Services. Conant calls him "my good right arm."



PHOTOGRAPHER AT WORK in Illustrative Studio. This studio is used for photographing inanimate objects. At left, camera setups for student picture program (see story).

M.I.T.'s Photographic Service occupies two floors of a large beautiful building and employs half a hundred people. It can provide just about any kind of reproduction the university requires.



PORTRAIT STUDIO and reception area.

out the world. On the day we visited, the work of M.I.T.'s own photographers was being shown.

Unitization was the key word in planning and is the key word in describing the photo-reproduction layout.

Frank Conant opposes mixing different types of photography in common negative darkrooms.

"Certain processes are just not compatible," he says.

The portrait studio has its own negative loading and developing darkroom and its own wash and developing sink.

Work from the illustrative studio flows directly into a cluster of small but well equipped darkrooms. The first is set up particularly for developing various sizes of black-and-white cut film. The next is for developing b & w roll films of various sizes in automatic tanks.

Directly across a narrow corridor is a darkroom for developing Ektachrome and Ektacolor. Adjacent are three rooms originally intended for Type C printing and enlarging. But because that program has been tabled for the time being, the rooms are presently being put to other purposes.

The enlarger originally intended for color work is being used for general purpose work. The developing area is being used for the processing of enlargements, and the finishing room, which has an additional sink and workbench, is being used primarily for developing 35mm negative film in automatic tanks.

Another unitized section is devoted exclusively to the making of copy negatives of various types of originals and the production of lantern slides. It, too, has its own darkroom with sizable sink, loading area, enlargers and contact printers for making slides.

For flexibility there is a large area devoted to general contact printing and enlarging, but which serves primarily the illustrative studio and copy camera. This area has several sizes and types of contact printers arranged along one wall of the printing room. Along the opposite wall is a bat-

continued on page 70

A small but significant part of M.I.T.'s activity in photography takes place in a section of the Civil Engineering Systems Lab.

by DANIEL R. SCHURZ
Massachusetts Institute of Technology

THE AUTHOR at work on a large photogrammetric stereo-plotter. With this device, data about terrain features, for example, can be prepared from aerial photographs for use in electronic digital computers, permitting rapid and automatic plotting of modern highways on a large scale.

Photogrammetric Methods For Experiment And Research

A relatively small but significant part of M.I.T.'s activity in photography takes place in the Photogrammetry Laboratory, a section of the Civil Engineering Systems Laboratory. In terms of staff, the Photogrammetry Lab consists of two faculty members, one full-time staff member, four graduate students and four part-time staff members.

Whereas its activities were originally confined to the teaching of aerial photogrammetry as a branch of surveying and mapping, its primary function at present is in conducting research and development for photogrammetric systems.

On the whole, this group utilizes metric photography ranging in scale from 1:4 to 1:500,000 to obtain precise three-dimensional information. This generally implies use of two or more cameras and necessitates using stereo-vision to correlate images from corresponding photographs. Such a method requires inter-camera distances which are relatively large in proportion to their object distances.

Research areas are broad and range from the development of general purpose high-precision laboratory stereo-cameras to the study and development of systems for analyzing the dynamics of fast-moving cloud systems.

A project related to the natural cloud studies is a program for determining the three-dimensional shape of man-made clouds resulting from high-altitude rocket-released chemicals. Multiple wide-base camera coverage from the ground is used for both cloud projects. Both projects are under sponsorship of the Air Force Cambridge Research Laboratories, the natural cloud studies in conjunction with Project "High Cue" and the man-made cloud studies, with "Project Firefly." (A detailed account of "Project Firefly" appears on page 58).

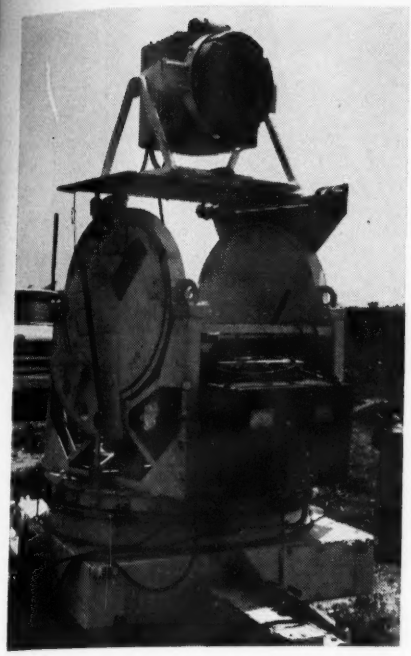
The laboratory has explored a number of other fields recently: X-ray study of the articulation of the human foot, structural model analysis, geologic mapping and the development of a digital output system for the 3-D stereo-plotter. The latter project, for obtaining highway location data, was the first of diversified sponsored research projects undertaken by the Lab since 1956.

Another Army-sponsored research project involves the simultaneous determination and adjustment of the geodetic positions and attitudes of all the photographs taken in a rectangular grid of roughly vertical aerial photos. In number the photos have run to 30 and cover hundreds of square miles. The actual analysis of the data is almost exclusively mathematical and computer-oriented as far as the Lab's role is concerned.

In cooperation with the Dynamic Analysis and Control Laboratory, M.I.T., the Photogrammetry Lab is working on a photogrammetric system for determining instantaneous surface definition of a hydrodynamic analog. The analog simulates the behavior of turbine gases in a supersonic state. The information desired is the variation in the height of the water surface for purposes of determining gas pressures and velocities to, in turn, analyze turbine performance.

Cooperative Effort

Sawdust is dropped into the incoming flow of water to define the surface for photographing. A



T-11 CAMERA on universal mounting. Upper trunnion and cross-leveling adjustments are visible, as is one of the capstain jacks for leveling the base. The 28-volt camera power supply is mounted on the rotating turret for convenience.

HORIZONTAL CLOUD PHOTOGRAPH taken with the T-11. At left appears, top to bottom, the 24-hour clock, the Calibrated Focal Length value, the exposure counter, the Metrogon lens serial number, the data box, and an altimeter.

grid of painted strings is located over the water area for reference and control.

The geometry of the analog represented a challenge to achieve maximum stereo effect and scale and yet cover a sufficiently large area of the analog. Experience in measuring the water table indicated need for a more suitable pair of laboratory cameras; consequently, cameras and a universal camera mounting for general laboratory use are in the process of being designed and fabricated at M.I.T.

Cloud Dynamics Study

The Laboratory is cooperating with the Cloud Physics Group of the Air Force Cambridge Research Laboratories in developing photogrammetric systems which will solve problems in gathering metric data on the growth and movements of natural clouds. Part of the Air Force's broad scientific program of atmospheric studies (known as Project High Cue), the research has created techniques for determining rate of cloud growth and vector velocities of specific portions of the cloud envelopes. Wide-angle terrestrial cameras of 9″ x 9″ format are currently used. Under development is a 35mm system for cine-stereo projection and measurement of clouds undergoing rapid dynamic changes in one or all dimensions.

The types of clouds under study are vertical cumulus developments and frontal developments along squall lines.

The problem of cloud measurement shares many features with other photogrammetric measurement problems on both the micro and macro scale. There are some notable differences as well.

Stereo measurements require a substantial ratio between camera base and object distance. In contrast to aerial mapping and missile tracking applications—where the ratio may approach and even exceed unity — the stereo-measurement of clouds has stricter limits imposed by the complex nature of the subject, the absence of well-defined image points or fine surface texture, lack of image contrast, and by the great range of depth to the cloud (or clouds) of interest.

Foreground features in clouds often mask more distant features. Double loss of stereo information results whenever a feature is masked in *either* picture perspective. Thus, operating base-distance ratios in excess of 3:10 are not generally feasible for detailed studies of vertical cumulus-type developments. Line squall situations, being primarily frontal, may yield useful data even with ratios of up to one-half or more.

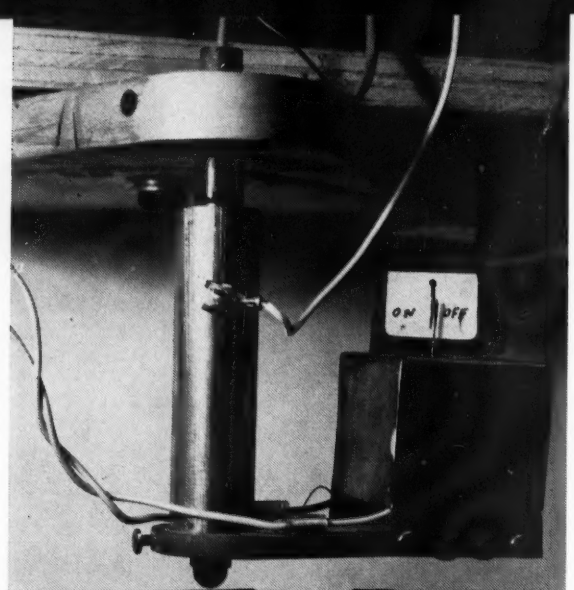
Field Setup

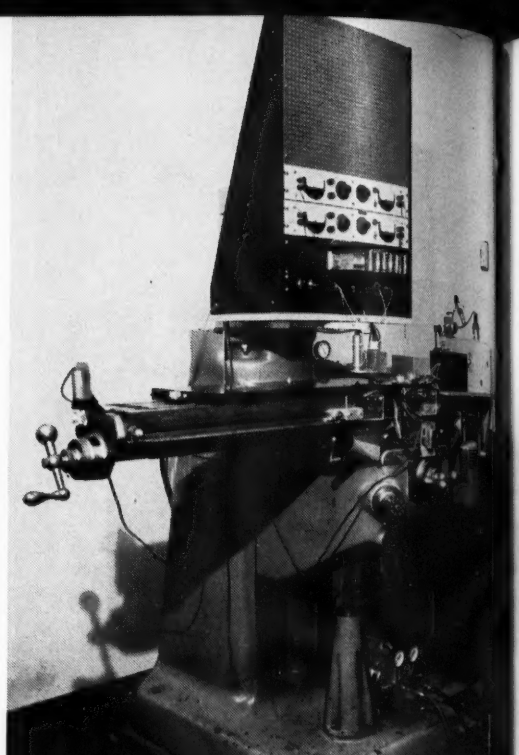
Most of the field work to date has been carried on in the vicinity of Flagstaff, Ariz., where the San Francisco Peaks and desert thermals generate a generous and predictable harvest of cumulus-type developments during July and August. The geometric camera array was selected and modified to give optimum coverage of the most statistically fruitful areas of cloud activity.

Three T-11 stereo cameras are positioned in a rough right triangle with an East-West leg of approximately two miles and a North-South leg of three miles. The useful 3-D information is obtained from the two-mile stereo base between seven and 20 miles to the North, and from the three-mile stereo base between 10 and 30 miles to the West. The East-West baseline is also utilized for the trial runs of the 35mm stereo system. The camera positions and the angular settings are determined by means of plane surveying techniques.

The master field location is

continued on page 66





AT RIGHT is an overall view of the milling machine modified at Lincoln Lab for the preparation of photographic masks for precision etched wiring. Above is a closeup of the light source. Note the piano wire linkage between shutter and solenoid.

by E. A. GUDITZ
Lincoln Laboratory

Machine Preparation Of Printed-Wiring Masks

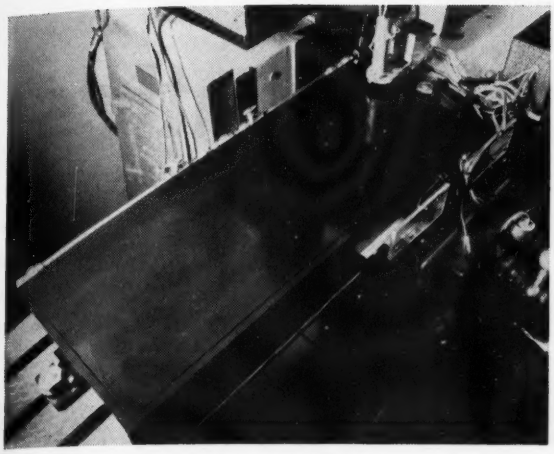
Lincoln technicians eliminate a major source of errors in making photographic masks.

A major source of errors in making photographic masks for precision etched wiring is the distortion introduced while photographically reducing master drawings to working size. However, such errors can be eliminated by direct exposure of high-contrast photographic film or plates with a fine pencil-like beam of light, and Lincoln Laboratory has developed a machine based on this principle that has produced 8 x 10-inch wiring patterns with line-position accuracy of plus or minus one mil from the pattern edge.

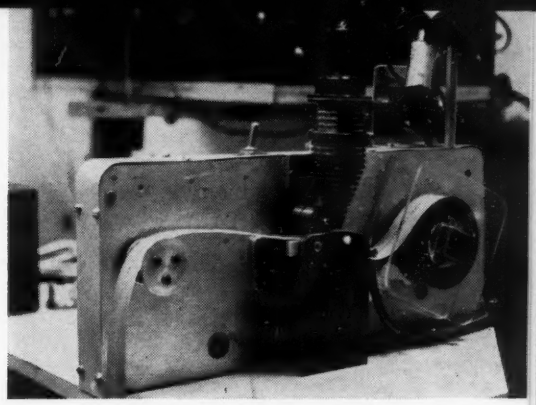
The unit actually is a modified milling machine. The maximum indicated table speed of 9-3/16 inches per minute was doubled by replacing the original 1,725 revolutions per minute drive motor with one rated at 3,450 rpm. The head has been replaced by a mounting plate which holds the light source.

The light source is a General Electric #47, six-volt, 150 ma. incandescent bulb mounted in a brass tube. The tube slides and rotates within a larger diameter brass tube for easy alignment of the bulb filament with the light nozzle below. A shutter actuated by an external solenoid interrupts the light before it passes through a beam-forming hole in the light nozzle. The beam of light diverges slightly as it leaves the nozzle, causing line width to be a function of nozzle height above the film. Ten sizes of light nozzles, each adjustable in height above the film, provide a continuous range of line widths from 0.002 to 0.065 of an inch. Alternative ways to adjust line width are to vary table speed or lamp voltage. Nozzle elevations generally are in the order of a few thousandths of an inch.

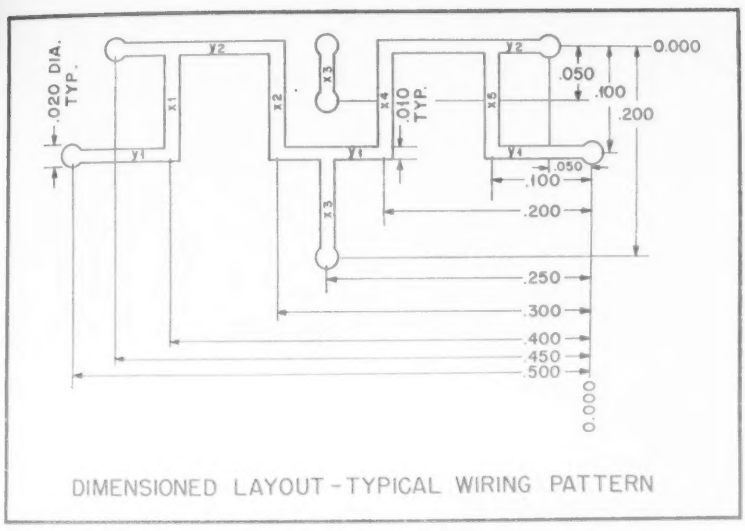
The semi-automatic machine is tape-controlled. The tape-reading mechanism is mounted on the movable worktable. It is powered from the main feed screw through a series of gears, eliminating synchronization problems. Tape speed is 100 times



GROOVED metal vacuum plate holds film flat under light source during exposures.



TAPE READER mounted on end of milling machine worktable.



faster than table speed, so the tenth of an inch spacing between feed holes of the seven-hole Flexowriter tape represents one-thousandth of an inch of table travel.

A Sylvania 1N77 photo-diode is used to sense illumination through one of the seven holes punched in the Flexowriter tape. *Figure 1* shows how a pulse output from the photo-diode, or a pushbutton, causes the state of a flip-flop to be reversed, energizing or de-energizing the solenoid which actuates the shutter in the light source.

Du Pont Cronar Ortho A Litho film is held fast on a grooved vacuum plate attached to the worktable.

The line pattern for the rows is exposed on one film and that for the columns on another. In preparation, a film is placed on the vacuum plate, a light nozzle of the appropriate diameter installed and table elevation and speed set to produce the line width required.

The tape for each line controls the light as the film passes underneath. Provision is made for reversing the control flip-flop (and light shutter) at the beginning of each pass so that the first hole to be sensed produces a line or a space as required.

Dots or lands at the ends of lines are made after the lines have been completed by manually positioning the table and making time exposures. Exposure time is controlled electronically.

The machine is housed in a darkroom so that the film will be exposed only to light from the controlled source. Low intensity, shielded reading lights are provided on the machine feed dials. A darkroom safelight is used during machine setup but is extinguished during exposures. The darkroom also contains film developing facilities for special tests.

Used Two Years

The machine has been used in its present form for about two years. It has been especially helpful in making miniature printed-wiring patterns, drive-line masks for computer memories and grid masks for solid-state display devices. Its advantages include elimination of artwork preparation and improved pattern accuracy over the particular camera installation it replaced. □

For a more complete description of this interesting technique, see the Transactions of the IRE Professional Group, Product Engineering and Production (PGPEP), 1961.

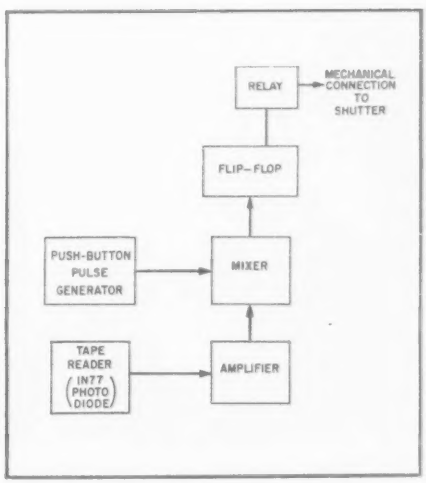
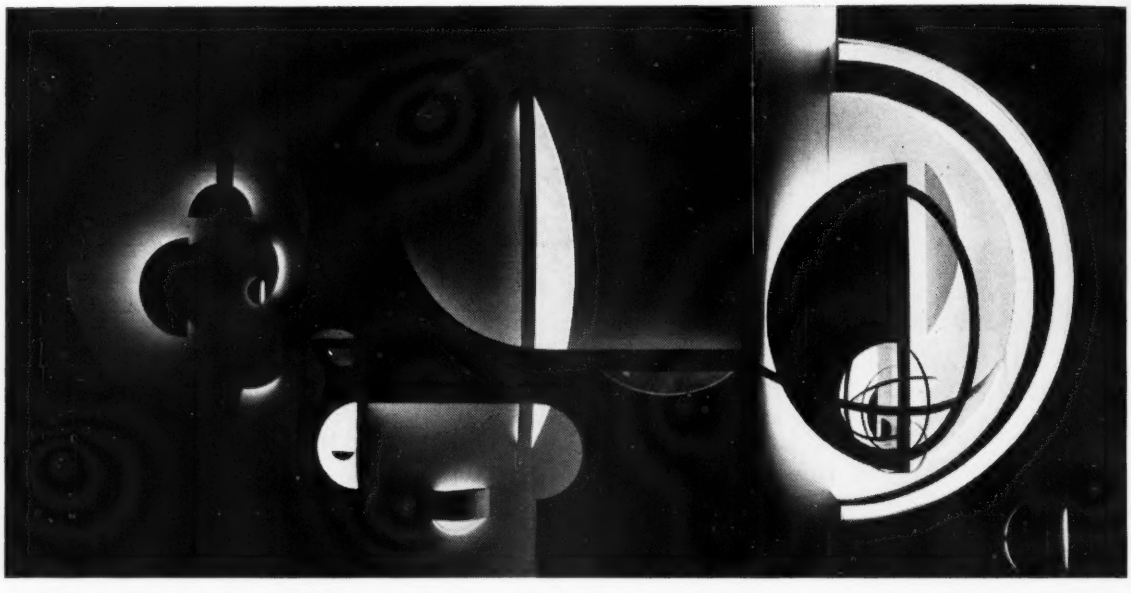
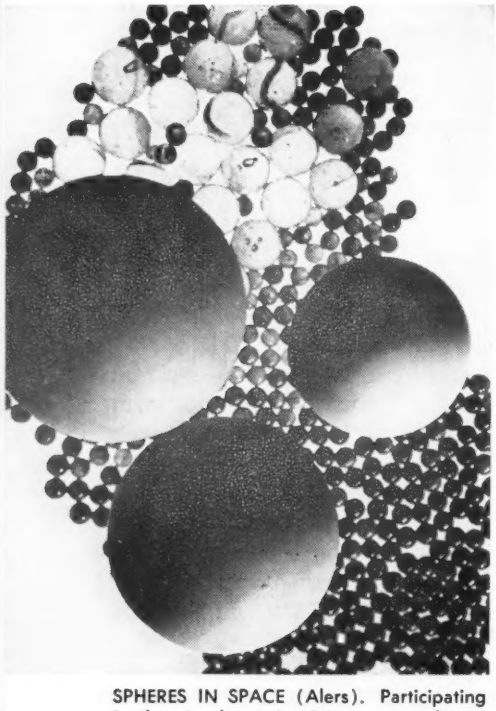


FIGURE 1. Block diagram of light-control circuit.

It's Not All Mathematics At M.I.T.



SPACE SEQUENCE with light modulation. A three-paneled mural with emphasis on continuity achieved by light (Haladay).



SPHERES IN SPACE (Alers). Participating in the visual arts is giving a new dimension to education at M.I.T.

by ROBIN WATSON
Massachusetts Institute of Technology

In the latest general catalog for M.I.T.—following such course titles as "Advanced Mineral Dressing Laboratory" and "Materials Separation Processes" — are some course descriptions that would warm the liberal arts heart but jar the parochial beliefs of those who see today's scientists and engineers submerged in a curriculum of narrow specialization.

"Form and Design," "Light and Color," "Visual Design Problems" — none of these would seem part of a Tech man's diet. Yet at M.I.T., since 1957 and since the Department of Architecture proposed that a program in visual arts be made accessible to *all* students, the School of Humanities and Social Science has included visual art courses as part of the electives from which each student selects an area of concentration in his junior and senior years.

An investigation into the neglect and the role possibilities of visual education at M.I.T. began as far back as 1952 when the school (supported by the Carnegie Corporation) appointed a committee for the study led by Dean John E. Burchard. The committee's recommendations supplied the framework for the present program.

Now, in fact, the visual arts program, a tenth field in the humanities and social science electives, is attracting students from more than half the departments of the Institute.

The architecture department and its faculty are responsible for originating and teaching these courses — men like Gyorgy Kepes, professor of visual design,

M.I.T. is intent upon overcoming visual illiteracy in an age increasingly dependent on perceptual awareness.

DISTORTION of object through glass (Enos).

INK IN WATER (Paukulis). Gyorgy Kepes, professor of visual design at M.I.T. and famous for his experimental photographic work with light, is making his students aware of what he calls "the new landscape."

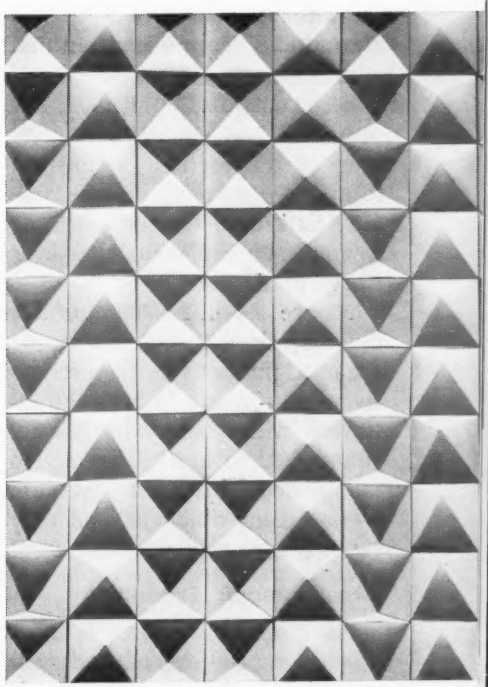
famous for his experimental photographic work with light; backed up by Associate Professors Richard Filipowski and Robert Preusser, and Albert Bush-Brown, architectural historian, who wrote *Architecture in America* in collaboration with Dean Burchard. These men and others help the young chemists and mathematicians, as well as the professional architecture student, to confront the problems of visual communication and to develop a critical understanding of art and design.

The undergraduate courses and the advanced visual design course for graduate students turn to photography as their analytical research tool — for studying light, for experimenting with its creation, enhancement or negation of form. The studying scientists and engineers (who, by the way, often prove by their performance that they have been looking all the while) realize particularly through studio experiences with a camera and some lights and an object that they can *see* in the real sense of the word. They realize that there are immense opportunities in designing with light.

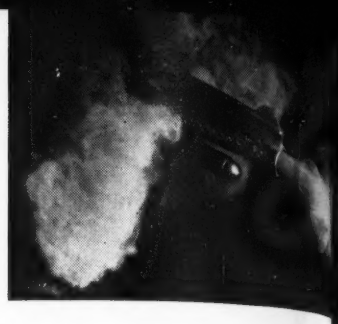
Photograms, made by exposing sensitized paper directly to light without a camera; drawings made by shining the light of a flashlight onto negative material and then printing; photographic comparisons of series of modifications in surface pattern on a patterned or textured object; montages; and multiple exposures are just a few of the ingenious uses of, and *around,* the photographic process and medium.

The nature of the photographic medium enables them to get down to the bare facts, to work with the basic elements of visual art.

continued on page 66



MODIFICATION OF SURFACE PATTERN by rearranging units in the same light (Parada).



EDGERTON OF M.I.T.

Meet the remarkable "Doc," who has revolutionized photography, created new industries and unlocked treasure chests of knowledge.

DR. HAROLD E. EDGERTON, engineer, educator, inventor, scientist, industrialist, photographer. . . . "great man."

by JAMES HUGHES
Executive Editor

"Take off your coat and come on into my 'darkroom,'" Dr. Harold E. Edgerton said. In that moment, as he extended his hand and smiled warmly, all the nervousness I had felt upon meeting one of photography's greatest technical innovators disappeared. His "darkroom" turned out to be a large soda cooler, its chemicals frosty bottles of Coke.

As we sat in his comfortable old lab, sipping soft drinks, he removed my last bit of apprehensiveness — where to begin an interview with a man who has accomplished so much. He started talking about his latest adventure — one from which he had only recently returned.

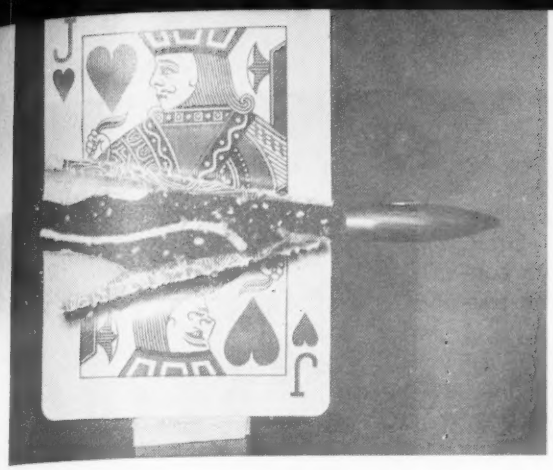
Oceanographic Expedition

As a member of an oceanographic expedition, he had voyaged 1200 miles from Woods Hole, Mass., to a point off Puerto Rico to photograph the ocean floor. For three weeks the only land he saw was that dredged up from three or four miles below. On this expedition, his photographs were instrumental in the discovery and recovery of rocks thought to be the first specimens ever obtained from the deepest layer of the earth's crust.

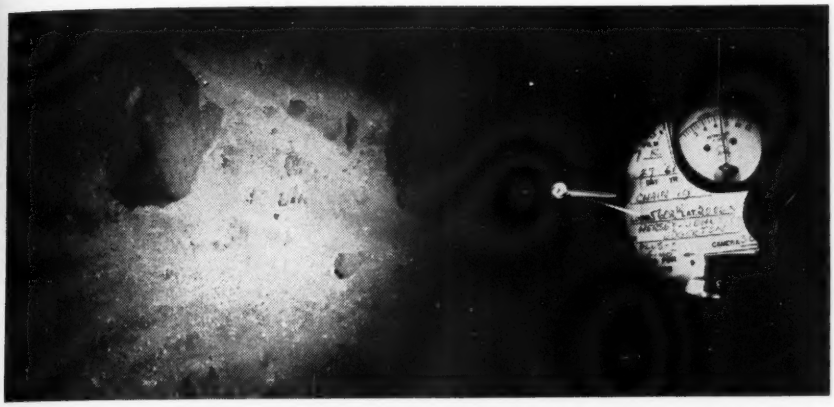
This was just the latest in a string of accomplishments that have earned for Dr. Edgerton the reputation as the world's greatest authority on deepwater photography. Working with the famous French oceanographer Cousteau and with the Woods Hole Oceanographic Institute, he has helped revolutionize man's study of what lies beneath three-fourths of the earth's surface. In four-mile deep water, once considered uninhabitable because of the crushing pressure of 5½ tons per square inch, cameras designed by Dr. Edgerton have revealed animal life. His photographs have shown for the first time rocks at the bottom of the sea and rare species in their own environment. Yet, Dr. Edgerton did not become seriously involved in underwater photography until middle life, long after he had already become famous as the world's greatest specialist in seeing the unseen.

Native of Nebraska

Harold Eugene Edgerton was born in Fremont, Nebraska, in 1903. After receiving his B. Sc. Degree in Electrical Engineering from the University of Nebraska in 1925, he moved on to M.I.T., starting an association, first as a graduate student and then as a faculty member, which has been one of the most important in the modern American academic world.



BALLISTICS — the science of the motion of projectiles — has intrigued Edgerton. Witness: the photograph above and the one at the top of page 40.



DEEP-SEA photograph made by Dr. Edgerton on his latest oceanographic expedition. It was made with a double-ended camera. At the same time that one frame of film is exposed to show what's in Davy Jones' locker, another is exposed to record the exact time, location, and whatever other data may be helpful later. This expedition to a point off Puerto Rico was made aboard the Woods Hole Oceanographic Institute's research vessel "Chain." The effort was sponsored by the Office of Naval Research.

Like many electrical engineers before him, Edgerton had always longed for better ways of seeing just what was going on in the whirring, speeding parts of motors and generators. This desire led him to stroboscopes — instruments for observing the successive phases of a motion by means of light periodically interrupted. He began experimenting with them in 1926, while working for his Master's Degree on the Cambridge campus.

The Strobe Era Begins

Edgerton didn't invent the stroboscope, but he might just as well have, for the modern instrument is largely of his making. As one scientist has put it: "The old strobe bears as much relation to Edgerton's as a World War I Jenny does to today's missiles."

Before Edgerton the strobe was pretty much just a challenging toy. It couldn't produce bright enough light at dependably regular intervals, the flashes were far too slow, and they couldn't be synchronized accurately with the speeding parts of a device to be tested. Edgerton overcame all these problems.

Basic As The Microscope

It wasn't long before Edgerton's stroboscopes were as basic a scientific tool as the microscope or the telescope, used in just about every lab and every industry. They were being used to adjust fan belts and balance automobile engines.

But Edgerton wasn't satisfied. He wanted permanent records — photographic records — of the action the strobe stopped so that it could be referred to again and again. In 1937, he started working with Gjon Mili, M.I.T. class of '27, and now one of the world's great photographers. Edgerton provided the equipment and Mili the eye. They started with the purely aesthetic and moved to that which was not only beautiful but functional as well. Incredible pictures of a gambler shuffling a deck of cards at arm's length, each card hanging in mid-air, shattered the boast that the hand was quicker than the eye — at least not the Edgerton eye. A now classic photo showing the lovely diadem made by a drop of milk also revealed a great deal about the surface tensions of liquids.

Historic Breakthrough

Edgerton had accomplished an historic breakthrough. In the words of Dr. Jacob Pieter Den Hartog, "Edgerton made alive what had been shown previously only through mathematics. He proceeded to show in mechanics, dynamics, all engineering, just about every area of scientific learning, the rules of nature in action."

Everything that moved on the land, sea or in the air became a subject for him. He took high-speed movies of diesel jets in action so that the efficiency of auto ignition could be improved; he took multiflash shots to show how ship models plowed through waves in the towing tank; and his high-speed photographs showed what happens to a plane wing in flight.

By 1939, the National Association of Manufacturers was able to cite him for "meritorious service to industry and to mankind in the creation of numerous new industries and countless jobs."

The War Years

Harold Edgerton is a peaceful man — a man dedicated to construction not destruction. Yet when World War II came along and the civilization he has sought to improve was threatened, he martialed his genius for battle.

In every theater of war his lights defeated the night — the friend of the enemy. On the night before D-Day, a plane

continued on next page

Edgerton

continued from page 41

carrying Edgerton equipment flew over the action area snapping breathtakingly clear pictures in sudden bursts of intense light. These pictures provided information essential to the success of the effort. In Burma night-time pictures made possible by Edgerton equipment caught the Japanese ferrying troops across the Irrawaddy River. In war he was as successful as he had been in peace.

After The War

When peace finally did return to the world it was an uneasy peace — weapons could not be forgotten. America's security depended on remaining strong. Edgerton again did his part. He went to Eniwetok for hydrogen bomb tests and under the most negative conditions possible made pictures which showed our scientists secrets that no eye could see when the big bomb went off. A firm which he had founded in the depths of the depression, Edgerton, Germeshausen and Grier, became the biggest private contractor in the atomic bomb testing field.

SUSPENDED ANIMATION. Edgerton's pictures of birds frozen in motion have been a revelation to naturalists.

Contributions To Defense

Edgerton has contributed to our defense posture in many other ways. Just to mention two, he has snapped pictures of microsecond flashes of rocket fuel, providing information vital to our missile program, and he has photographically documented how metals bend and break under tension, information vital to the construction of planes, ships, tanks and other vehicles of war.

Explosive Studies

The fields of ballistics and explosives are naturals for Edgerton. Within recent years he has photographed bullets in flight without a camera. Through double-flash photos he has frozen on film high-velocity particles and gases from exploding dynamite caps. Other fast transient events which he has photographed include flame fronts and high-velocity shock waves.

Edgerton's curiosity has taken him into all fields. His movies have shown exactly how a cat held upside down lands right side up when dropped. He showed aeronautical engineers and naturalists how birds, especially hummingbirds, use their wings. He proved that drops are not tear-shaped but flat-bottomed globes.

"Sports Photographer"

A sports enthusiast he has, through analytical photography, helped improve performances in a variety of events. His stop-action photographs of pole vaulter Bob Richards helped that athlete break through the 15-foot barrier. He rigged up flash equipment with a Polaroid camera, which develops pictures immediately and allows a swimming coach to show a diver his mistakes as soon as he climbs out of the pool. His camera and lights have shown that a golf ball and club are in contact for only five-thousandths of a second while they travel together for approximately a half-inch.

A DRAMATIC EXAMPLE of what high-speed photography can do. It makes possible complete motion analysis of fast transient events. What it can do for a tennis serve, it can do for a lathe or any other industrial machine. Harold Edgerton made it all possible.

Within our allotted space we have been only able to partially catalog the ways in which Dr. Harold E. Edgerton has touched the lives of everyone and changed the course of photography and a world of other fields. We have been able to detail none of his accomplishments for each is a complete and different story in itself. We do hope, however, that we have been able to enlarge the appreciation of this remarkable man.

Recognition

Fortunately — and unlike too many other men of genius — Dr. Edgerton's work has not gone unrecognized in his own time. He has received almost every engineering and photographic award for which he is eligible. To his students and associates alike he is, in the words of Crawford H. Greenewalt, president of Du Pont, "A Great Man." □

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GRANSTAT'S *High Speed* lets you handle more jobs per hour—for *faster, more economical production.*

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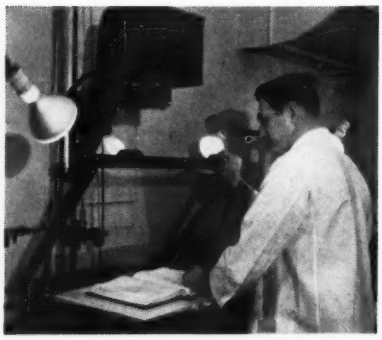
THE AUTHOR, left, wears many hats. Besides being head of M.I.T.'s Microreproduction Lab, he is chairman of an American Standards Association committee and an American Library Association committee. Author of numerous articles, he is also Assistant Editor of *American Documentation* and on the Editorial Board of *National Micro News*. He is a member of the National Microfilm Association's Committee on Research. The other pictures on this page give some idea of the well equipped facility he administers at M.I.T.



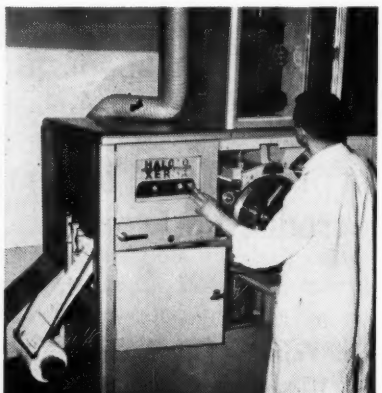
M.I.T.'s Microreproduction Laboratory

One of the most respected and successful exponents of all microphotography describes his home base.

by PETER SCOTT
Microreproduction Laboratory
Massachusetts Institute of Technology

When did the book cease to be a satisfactory means of storing and disseminating scientific and scholarly information?

The very question is by many considered sacrilegious, but the growth of the research library is proceeding at a continuously accelerating pace and somewhere along the line, the book, as we know it, grew too heavy, too bulky, and too inelastic, to constitute an altogether satisfactory means of storing and using scientific information.



While the shortcomings of the book are recognizable, improved information handling systems are slow to be developed. Whenever photography or electronics offered improvements in storage and retrieval they appear to have been at the expense of reading comfort.

The microfilm industry recently celebrated the centennial of microphotography in recognition of the work of early pioneers, including the extensive use of microphotography during the siege of Paris. Perhaps it should have been called the centennial of the *art* of microphotography since as a *science* microphotography is young, 30 years at most. The popularization of the 35mm camera tempted many a scholar to devise his own microphotographic system. The miniature camera and an improvised copy stand and lights, sometimes of a portable nature, served as a simple form of microfilm camera.

We have come a long way since then, with an impressive volume listing microphotographic equipment available in the U.S. and a fast growing National Microfilm Association.

As yet libraries have not been offered microfilm systems as useful to them as industrial microphotographic systems have been

continued on page 92

The Hasselblad: its limits are the limits you set

Inspiration is what the Hasselblad 500C 2¼″ x 2¼″ camera was created for. It handles everything from micro work to telephoto work. The secret? The system—the Hasselblad single-lens reflex system of interchangeable lenses (from 60mm to 500mm), film backs and accessories.

For your work, change to any one of 5 Zeiss lenses each with an automatic preset diaphragm in its Compur shutter synchronized for all types of flash at all speeds (1 sec to 1/500). Each with automatic depth of field indicators. Switch viewers (5 to choose from, including eye level prism). Switch film backs: three for roll film, one for cut film. Switch to Proxar lenses, extension tubes, bellows extension or microscope adapter; every accessory is precision matched to the one camera. Write Dept. HIP-11 for the name of the nearest dealer.

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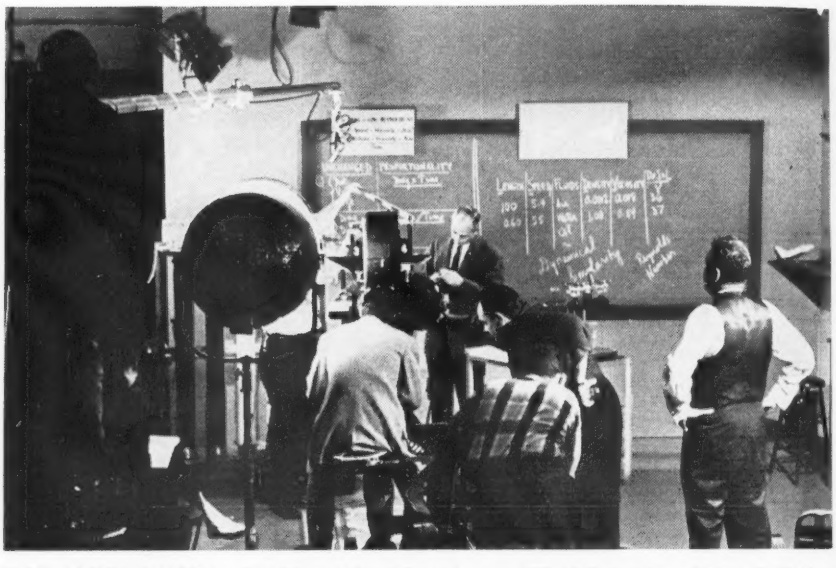
Paillard Inc., 100 Sixth Ave., N.Y. 13, N.Y.

Accessories shown include: 60mm (on camera), 150mm, 250mm Zeiss lenses; Super-Wide C Camera, extra backs, bellows extension, magnifying hood, sports finders, micro-adapter, extension tubes, rapid crank, filters and new Pentaprism. Hasselblad 500C with 80mm lens $549.50.

HASSELBLAD

A Quiet Revolution Sweeps America

M.I.T. sparks program which meets Soviet challenge to our scientific prestige.



PROF. ASCHER SHAPIRO of M.I.T. is filmed lecturing on "Fluid Dynamics of Drag." Motion pictures exposing high school students across the country to the nation's finest scientific minds constitute the most concentrated use ever of film in the application of audio-visual teaching techniques to physics education.

The challenge to our scientific prestige by the Soviet Union is being met in the physics classrooms of American high schools by the most concentrated use ever of film in the application of audio-visual teaching techniques to a particular area of education. The films are part of one of the most dramatic, important and revolutionary educational programs ever undertaken in the United States.

Disturbing Condition

Seriously disturbed by the state of secondary-school physics in the United States, the nation's scientific leaders in 1956 decided to do something about it. That "something" was the organization of the Physical Science Study Committee at M.I.T. to devise a modern course in physics for high schools and to prepare materials for such a course. Dr. Jerrold R. Zacharias, Professor of Physics at M.I.T., was chairman of the committee and is still its guiding spirit.

The committee quickly realized that only through the use of visual aids could the high school physics teacher be assisted in an outside-the-classroom approach to modern physics, and a motion picture program was written into the plans. An indication of the high level to which the committee aspired is indicated by the caliber of people it asked to help them formulate the motion picture phase of the program. Among them was Frank Capra, generally regarded as one of the great directors in motion picture history.

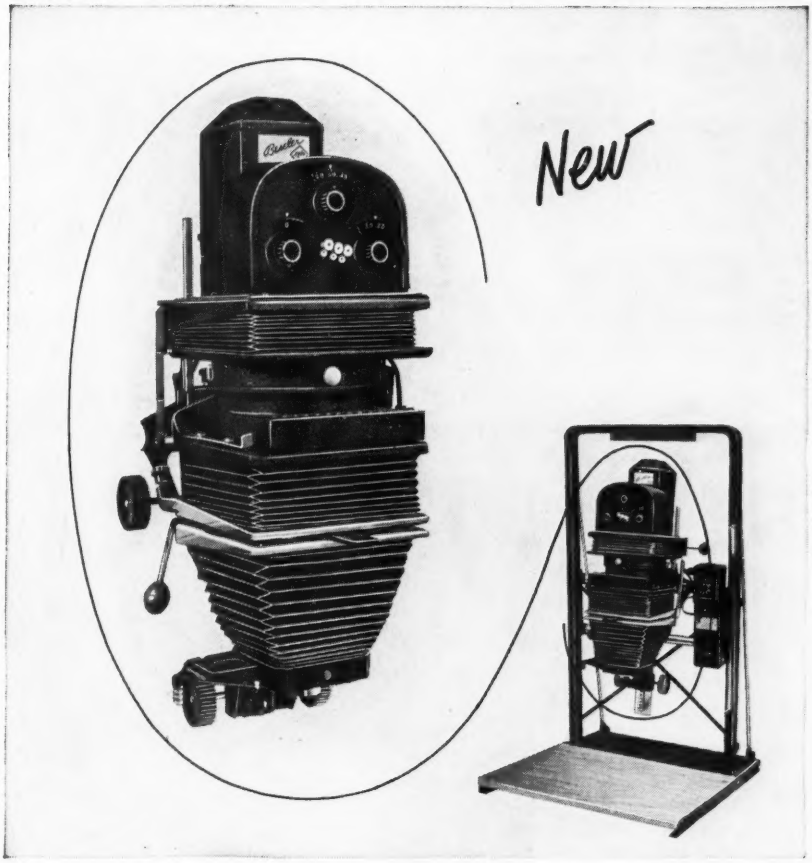
Heavy A-V Emphasis

Although the work of the committee has included a variety of textbooks, pamphlets and other classroom aids, heavy emphasis has been placed on developing better student understanding

continued on page 57

PROFESSORS WILL even hang by their knees if it will help the cause of science. Here Prof. Donald Ivey makes a scientific point for the motion picture cameras.

3 *exciting innovations from* BESELER



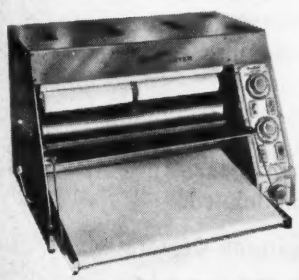
Beseler-Agfa Colorhead

Brilliant Single-Source Colorhead with dial-densities from 0 to 199—and fade-resistant Type-C filters. Now all 4x5 Beseler owners can profit from the teamwork of two of the greatest names in photography—Beseler in America and Agfa in West Germany. Designed for American methods and materials, the new head provides fade-resistant Type-C filters in densities from 0 to 199 in all three subtractive colors—yellow, magenta, and cyan.

Single high-intensity 250 watt lamp remains color-constant after hours and hours of printing. Brilliant triple condenser design provides the fastest printing speeds possible with all negatives from subminiature to 4x5 with true condenser sharpness.

New

Glossomatt Color Print Dryer



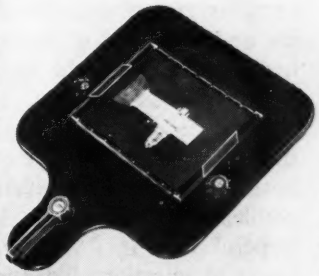
Midget Glossy Color Dryer Does Giant Job—Now every darkroom can afford an automatic glossy color print dryer—the new Beseler Glossomatt. This miniature workhorse requires only 18x23 inches of shelf space—yet dries prints **16 inches wide.**

Exclusive dual-element heating system and triple layer drum (copper, stainless steel, and chrome plate) provide precise, total surface temperature control.

Exclusive safety features let you leave immediately after the last print.

New

"Negaflat" Carrier



Glass Carrier Flatness—Without Glass—At last! A 4x5 **glassless** carrier that holds negatives **as flat as glass.** Beseler's exclusive Negaflat does away with breakage, Newton rings, and the dust and dirt associated with glass carriers. Special clamps firmly hold the edges of the negative and gently pull it taut for perfect flatness overall.

Now even film-pack negatives are easy to print. And wet negatives can be printed as easily as dry ones.

For information and literature write to:

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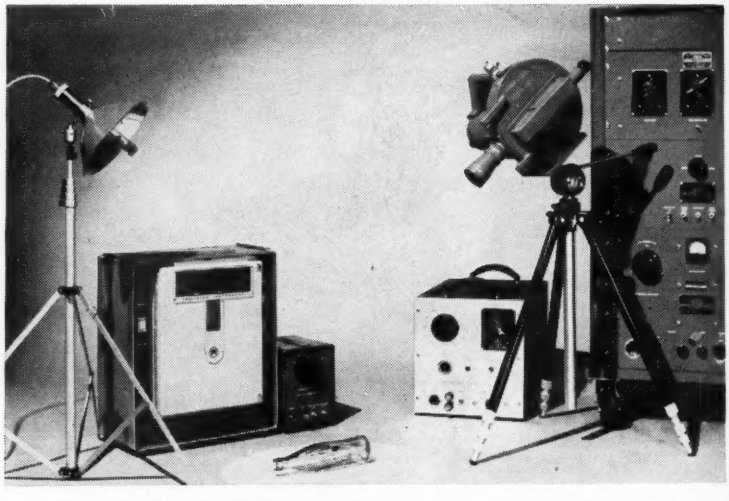
THE GREAT BAT MYSTERY

BATS CAN HEAR an echo from a target as tiny as a mosquito.

High-speed photographs reveal a technique 50 million years old— how bats hunt with sound.

by J. J. G. McCUE
Lincoln Laboratory



WITH THE HELP OF HIGH-SPEED CAMERAS and devices for recording and analyzing ultrasound, Dr. McCue and his associates are examining the details of bats' evolution-perfected system of finding food.

High speed photographs of brown bats swooping in on ir-tossed mealworms may provide new inspirations for radar and sonar designers. Manmade craft have had navigating and hunting by echolocation for less than 30 years, whereas bats have been doing these things for half a million centuries. They send out pulses of sound pitched far above the range of human hearing, and then evaluate the echoes to find the direction and distance of each object within range.

With the help of high-speed cameras and devices for recording and analyzing ultrasound, we hope to examine the details of this evolution-perfected system. How does a bat recognize his own echo in a cave full of other bats? How does he distinguish edibles from obstacles? We are hopeful that in finding the answers to questions like these, we will gain insights that can bring about improvements in radar techniques.

Frederic Webster, a private scientist, initiated the present photo-acoustic study of bats, and much of our work is carried out in a quonset hut in the backyard of his home in Cambridge.

Mealworm Mortar

One of the key accessories in this study is a magnet-powered mortar developed by my associate, David Cahlander. It tosses mealworms to a predetermined spot, placing them accurately in the field of the camera, thus removing the uncertainty of focus that prevails when a bat is catching flying insects, his natural food.

In a typical experiment, the gun lofts a mealworm into the air, the bat senses it, and a modified Fastax running at 768 frames per second records his movements. At the same time, a tape recorder running at 60 inches per second memorizes the acoustic signals sent out by the bat. His pulses lie in the range 20 to 100 kilocycles per second, and last for times on the order of a millisecond; they are usually frequency-modulated.

Used As Streak Camera

The Fastax is used as a streak camera, the framing being done by high-speed electronic flash,

continued on page 54

available again

by popular demand!

STROBOFLASH*·I

Back again is our efficient . . . light weight . . . compact electronic flash unit. Powered by high voltage batteries; you are sure of professional *reliability* and *rapid recycling*.

Need a handy slave sidelight? Stroboflash I becomes one with the addition of an inexpensive Phototube Assembly . . . eliminates long extensions and trigger cords. When you need a balanced multiple light source team-up Stroboflash I's 50-watt second energy with any Stroboflash IV at ¼ Power Setting. All Stroboflash power packs, lampheads and cords are interchangeable. There are no *off-on* switches to forget.

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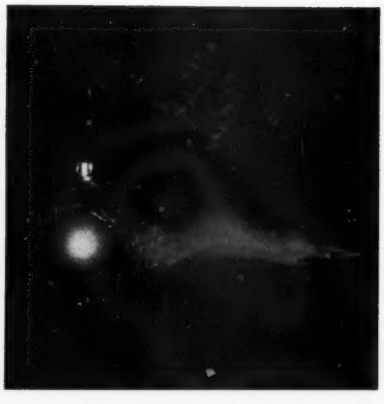
Unusual Students Turn Out Unusual Pictures

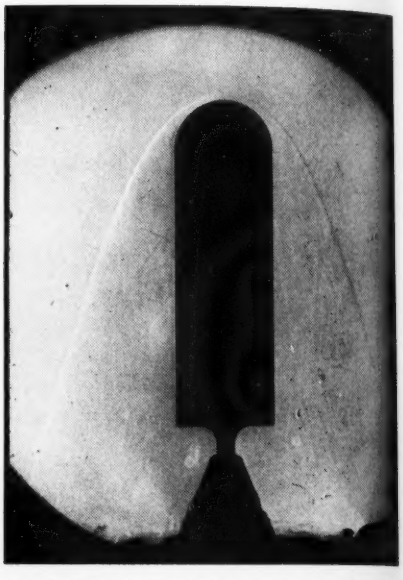
Tomorrow's executives are acquiring a healthy respect for industrial photography.

by BOB SCHILDKRAUT
Massachusetts Institute of Technology

The author of this article is a senior in Electrical Engineering at M.I.T. An interest in the photographic process rather than in taking "pretty pictures" led him to purchasing his first camera nine years ago. His photographs for the most part are of a technical nature, but he does occasionally take pictures which, as he puts it, "have relatively little scientific value."



CHRISTMAS MORNING at the strobe lab. A 30-caliber bullet traveling through an Xmas tree ornament at 2800 feet per second. A half-microsecond exposure.



A SCHILDKRAUT SCHLIEREN photograph of a blunt cylindrical model in a Mach 13 shock tunnel during time of steady flow. Single shot-exposure duration: 5 microseconds.

For the well-rounded student or the student who requires a change-of-pace from the intense atmosphere of curricular work at M.I.T., an outside activity or a playful offshoot of one's work seems necessary. Fortunately, a student can find a diversity of ways to occupy free time at M.I.T.: photography ranks high on the list of preference.

Students participate energetically in many phases of photography — journalistic, industrial, technical, visual design. It is not unlikely to find a student one day covering a special lecture and the next day taking pictures of a bullet penetrating a chocolate eclair.

Profs Point Way

The many professors who apply photography to their areas of specialization are responsible for the eminence it holds among the students as a research tool, as a way of looking and seeing, capturing and measuring. Dr. Arthur C. Hardy, professor of optics and photography, retired this past year, but his great contributions and developments in optics and color analyzing continue to stimulate student interest and research in those areas.

Edgerton's Influence

Dr. Harold E. Edgerton has been educating industry as well as M.I.T. students for years in the technical advantages and uses of photo-instrumentation. His students, the scientific, engineering and corporation leaders to come, are becoming aware, for future use, of the photographic and photo-measurement techniques available to them and industry.

Dr. Edwin Land, visiting Institute Professor, is in constant contact with M.I.T. undergraduates. His special lectures, which usually inform the students of his latest interests and developments, are always jammed to capacity.

In my past five summers working in industry, I have been able to put to significant use the photo-instrumentation experience gained from work in M.I.T.'s Stroboscopic Lab. I have discovered that in the industrial world a vacuum exists in the field of high-speed measurement which can only be filled by specialized knowledge and familiarity with the potentialities of photo-instrumentation. Regardless of the amount of cooperation from well-informed, progressive management, few companies have staffs sufficiently skilled or trained in this area.

Important To All

It is important for all technical people — managers, engineers, or technicians — to be aware of the knowledge and equipment they can turn to. In hopes of familiarizing more students with this problem and this specific area, a seminar concerning high-speed photo measurement is offered to M.I.T. freshmen this term.

continued on page 52

"For the MONEY pictures we bank on Rollei"

says Vince Finnigan
noted Washington photographer

bicycle built for three . . . for those rush news assignments, Vince overcomes the parking problems around Capitol and White House with a **no-parking-problem** bike. His **workhorse trio,** Rollei normal, tele and wide angle, are constant companions.

"When you're shooting a *money* picture, especially on fast news assignments, there's no time for fooling around. *You've got to be sure.* And I make sure with Rollei . . . normal, tele, or wide angle . . . whichever is best suited for the job. With Rollei, and only Rollei, you get the essential combination of speed in shooting, perfect control of composition, unsurpassed picture quality, and negative size large enough for *all* requirements" says Vince Finnigan.

Rollei cameras are available for *all* needs of professional and amateur; including f2.8 and f3.5 models with or without coupled meters. Also the 3.5 Rolleimagic, the fully automatic Rollei. Examine them at your dealers to-day—or write now for illustrated literature describing all Rollei models.

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unusual students

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Student activity leaders find that they have photographic problems not unlike those many companies have. M.I.T.'s Lecture Series Committee, a non-profit group whose free lecture program brings notables to the M.I.T. campus, spends much of its overall efforts in public relations work and publicity for its frequent events.* The most effective publicity is through posters tacked up on Institute bulletin boards, and these posters must be eye-attracting through use of color.

Originally, silk screen posters with six or seven colors were used. However, an increase in the number of posters required has made silk screen methods too time consuming for a small staff with limited hours to spend on this project. On the other hand, the number of posters required doesn't make four-color offset printing practical. The problem then is to produce per week approximately 50 full-color posters with high color saturation — without going into an involved and lengthy process.

**The committee finances its lectures and a classic film series through a series of popular entertainment films shown weekly on the M.I.T. campus.*

Scientists at M.I.T.'s Instrumentation Laboratory visualize a space vehicle which would fly up to Mars, take a picture of the planet and bring it back to be developed. Under their plan a 340-pound vehicle-about the size of a table model TV set – would carry a camera which would photograph nearly half of Mars' surface from 4,690 miles above the planet.

A pilot project was set up which made use of the Type C print process for small-lot reproduction purposes. Original artwork was photographed on color film and then duplicated on Ektacolor paper. The tremendous flexibility of the process allows the colors to be varied easily and the format to be changed without necessarily having to return to the first step of the process.

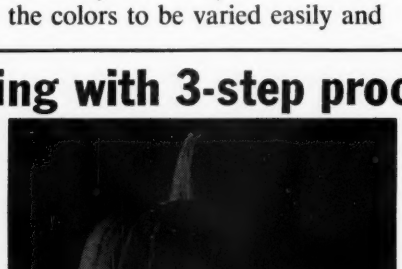
In addition, three people can produce a week's worth of material in a relatively short time. The added flexibility permitted in this process through use of the Ektacolor Type S film and the opportunity to incorporate photographs in the posters were both points for the project's acceptance.

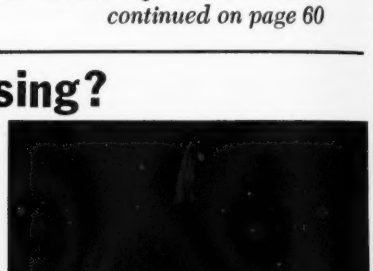
Although there are numerous photo labs at M.I.T. and in the surrounding Cambridge-Boston area, there was no convenient lab equipped to handle the specialized Type C poster work. Outside firms could not execute the critical color balance needed for montage-type posters with overlettering at a cost which the committee was prepared to pay. Consequently, LSC decided to completely outfit its own Type C color lab.

The Institute provided a room

continued on page 60

Why risk overdeveloping with 3-step processing?





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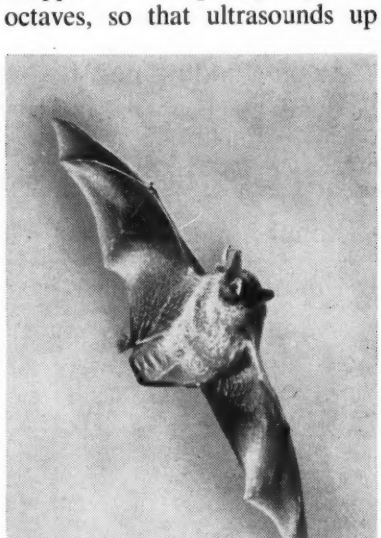
Circle No. 565 on Post Card

bat mystery

continued from page 48

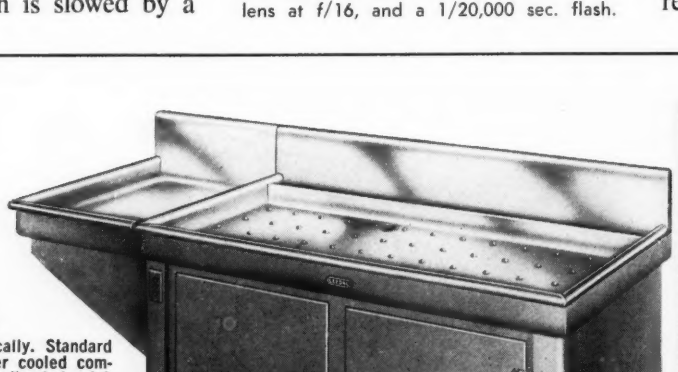
developed at M.I.T. by Dr. Harold Edgerton. Each flash lasts 1/10,000 second. Mr. Cahlander has applied to the Fastax an ingenious servomechanism that keeps it running at constant speed, to simplify the problem of adding a soundtrack to the final print. This electrical accessory also triggers the strobe flashes: in addition, it generates a reference waveform that is recorded on an auxiliary track on the tape.

The reference waveform serves to synchronize the tape and the negative when they are combined to produce the final 16 mm print. During this operation, the tape is played back at 1⅞ inches per second. When the final print is projected at 24 frames per second, the motion is slowed by a factor 32, and the sound is dropped in frequency by five octaves, so that ultrasounds up to about 250,000 cycles per second are made audible. So far as we know, this equipment is the first that produces slow-motion sound movies of ultrasonic events. It should have a range of applications to industrial problems.



BAT CLOSES IN ON MEALWORM. This still was made with a 70mm Veritron camera using an 8½-inch Commercial Ektar lens at f/16, and a 1/20,000 sec. flash.

It has been supposed that a bat may frequency-modulate his pulses so that he can hear a beat note between his voice and a returning echo. The distance to the echoing object could then be inferred from the frequency of the beat note. Radio-altimeters work in this fashion, but our sound movies give no support to the suggested theory. It appears that our local bats, like most radars, judge range by sensing the time-delay between the outgoing pulse and the echo. Direction is presumably judged from the differences in the sounds reaching the two ears. □



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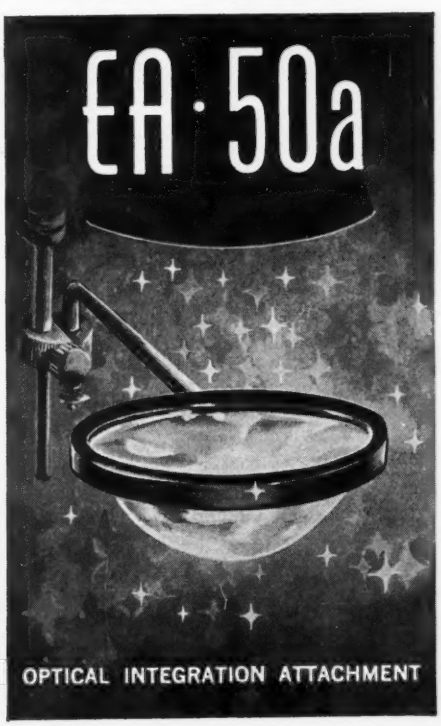

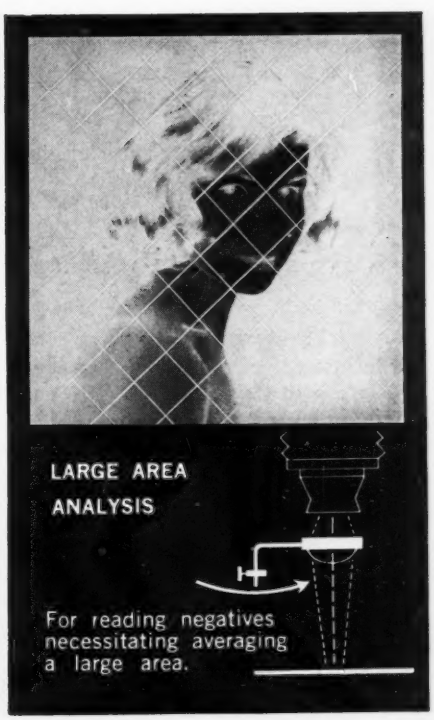

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▪ With these attachments (and there are more to come) and the greater all-around sensitivity, stability and ease of use inherent in the EP-1000 Photometer, you have *versatility without limitation*, an instrument line without equal, designed to grow with your need. For descriptive Brochure or a demonstration of the Macbeth QuantaLog Model EP-1000 and attachments, please circle the control number shown below.

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Gevapan Sheet Film, used in this Willys Motors series of product photographs, has the built-in latitude that cuts down costly retakes. Even professionals welcome a film that copes with *all* the mechanical and human variables in difficult location assignments. And incidentally, all prints on these assignments were made on Gevarto Enlarging Papers!

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Correctone CO-23. The unique film for continuous-tone copy work.

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quiet revolution

continued from page 46

through motion pictures. Today motion pictures are utilized on a mass basis as an integral part of the new science curriculum developed by the committee and now in force in more than 1,000 schools throughout the United States.

Once the groundwork was laid, headquarters were established in the Boston suburb of Watertown, Mass., where an old Loew's theater was converted into a motion picture studio for the production of the educational films.

To convert the movie house into a production studio, most of the theater's 650 seats were removed and a level wooden floor built from the theater stage over the lower part of the orchestra. This stage extension provided about 3,000 square feet of unbroken studio space equipped with lights, and sound-conditioned to form a first-class shooting stage. In addition to the sound stage there are editing rooms and three shops to feed stage experimental equipment. The preparation of equipment that will film well is an important and unique part of this operation.

The first films to come out of the studio were the work of outside producers. However, it was found that for the sake of communication it was better to rely on a house unit. Thus today all the films are the product of the program's own in-plant motion picture unit headed by Kevin Smith, a former CBS executive, who finds this "the most satisfying work I have ever done." Working with Mr. Smith are three staff directors, two cameramen, two sound men, three stage crewmen, a script clerk and a unit manager. When needed additional crews are put on and the talents of free-lance directors are employed.

These professionals use the most professional of equipment. A Mitchell BNC 35mm is their studio workhorse. An Eclair Camerette serves as silent pickup equipment. In the 16mm range the unit owns an Auricon 1200 and Mitchell 16s. Specialized equipment — such as high-speed cameras — are rented as needed — and they are needed. The unit has filmed high-speed sequences ranging from 140 to 3,000 fps.

Most films are shot on 35mm black-and-white stock, but release prints are 16mm. Sixteen millimeter Ektachrome is used when the subject matter dictates color, as in a film on elements and compounds, and another on photoelectric effects. One film has been done on 35mm Eastman color. The bulk of the unit's footage is processed by De Luxe Laboratories in New York, although some has been done by Movielab and Byron.

continued on page 63

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ABSOLUTE REPEATABILITY – The patented *MAGNEPHOT SYSTEM*, employed only in Welch Densichrons, converts direct phototube output into a constant pulsating output. Gives A.C. characteristics . . . eliminates *ALL* the shortcomings of D.C. amplifiers.

EASY TO USE–CC values and black and white exposure time readings are direct from meter scale. Wide spread readings can be made with hairline accuracy by use of High-Low range switch.

VERSATILITY – May be used with "Densichron" Transmission Light Source for off easel color balancing or black and white prereading negatives outside the darkroom. It will not interfere with Photometer's use, for Light Source can be disconnected in seconds.

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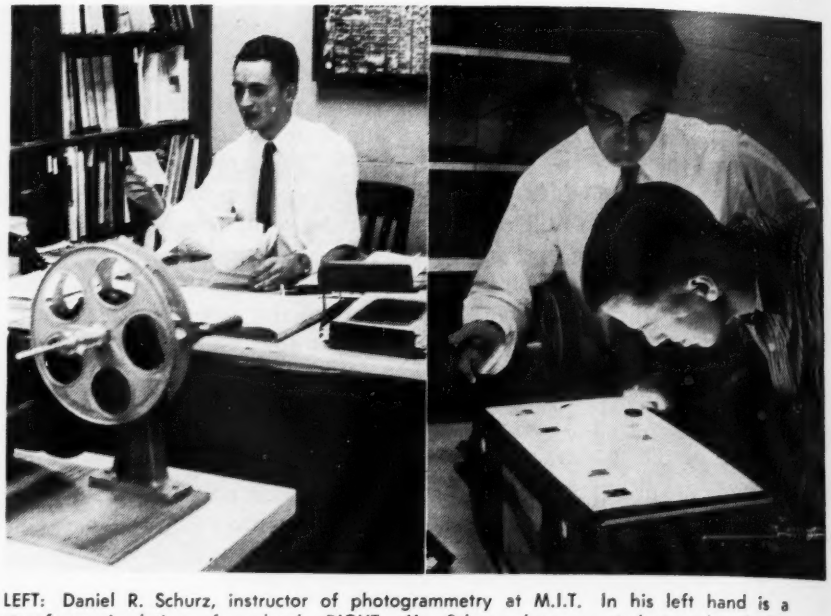

LEFT: Daniel R. Schurz, instructor of photogrammetry at M.I.T. In his left hand is a styrofoam simulation of a cloud. RIGHT: Mr. Schurz shows a student reduced diapositives of man-made chemical clouds photographed in conjunction with the Air Force's Project Firefly. This project promises new knowledge of the atmosphere.

Project Firefly

Cloud simulation work is currently claiming the attention of M.I.T.'s Photogrammetry Lab. This is a phase of the Air Force Cambridge Research Laboratories' "Project Firefly" — a study of the upper atmosphere in the 100km-plus region. One objective of this project is the study of diffusion and winds in this region, and photogrammetric techniques are best suited for this study.

The cloud simulation work has resulted from a need for storing and representing easily comprehended information about three-dimensional cloud shapes. The clouds are photographically documented by AFCRL at successive instants of time, generally over a period of five minutes or so. The irregular growth of the cloud during this period gives useful indications of the diffusive, and other, characteristics of the atmosphere under the existing conditions.

The cloud shape simulation is based in the geometry of intersecting projective envelopes (irregular cones). The model of the cloud is constrained to be within all the irregular cones formed by reprojection of the multiple photographic outlines. Surface contrast gradients in most cases are so low that stereo methods are not generally successful. Moreover, stereo methods show only one face of the cloud at a time.

The medium for preparing the cloud models is Styrofoam. The models are obtained by reprojecting the rays forming the cloud's photo outline through a Styrofoam block from perspective positions which correspond to the camera positions relative to the original cloud. The scale of the models is 1mm equals .15km; hence, a model four inches long corresponds to a cloud 15km long.

The projective envelope approach is most successful where the cloud has a relatively non-complex shape, such as a 3-D comma, spiral or ellipsoid. The more and varied the perspectives, the more exactly the shape may be determined; i.e., the raw model exhibits more facets which, therefore, more closely conform to the real cloud. Practical problems limit the useable projections to three, ideally with a 60-60-60 degree or 90-90-90

continued on page 60

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SCOTCH® BRAND TENZAR backed tape . . . provides extra strength at no extra cost!

Here's a recording tape built to take hard wear! It's "SCOTCH" BRAND Magnetic Tape No. 311 with exclusive TENZAR® backing. Use it continuously . . . with rough, inexperienced handling . . . fast stops and starts . . . long storage periods—and it will record and play back faithfully over and over again!

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And on the recording side, high-potency oxide assures the perfect sound reproduction quality that has made "SCOTCH" BRAND Recording Tapes famous. In addition, exclusive Silicone lubrication gives effective, lasting protection for your recording heads. For the highest quality recording, with an extra bonus of strength and long service, ask for No. 311 with TENZAR backing next time you order recording tape. Available in clear or red, blue, green, and yellow transparent color-molded reels. **Free in each box**—end-of-reel tape clip that prevents tape spillage in handling and storage.

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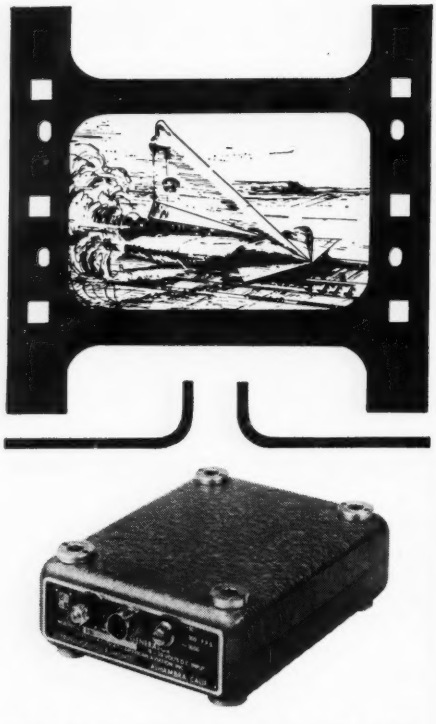

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The Steinwood Tri-Pulse Generator provides for precise comparison of simultaneously recorded action. A preselected frequency of 10, 100 or 1,000 pulses per second can be recorded on the film of up to 10 cameras, enabling the data reduction man to correlate information from a known time standard.

COMPACT — Less than 1.5 pounds.

RELIABLE — Performs within 1% of selected frequency.

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RUGGED — Operates under heavy G loads.

SELECTIVE — 10, 100 or 1,000 pulses per second.

POWERFUL — Feeds pulse to as many as 10 timing lights.

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project firefly

continued from page 58

degree angular separation (a pyramid-shaped coverage) between the axes of the cameras.

An integral part of the cloud simulation process involves calculation of cloud position data — latitude, longitude, and elevation — using star background for reference. This information is supplied by Georgia Tech, working under Air Force contract.

M.I.T. Photogrammetry Lab. follows through with a step-by-step technique for preparing cloud models:

1. Reduced glass diapositives are prepared for compatibility with the 55mm projectors in the Balplex Stereoplotter. The downward-pointing projectors simulate the original taking cameras and their orientations in an upside-down fashion.

2. A base manuscript is prepared showing plan positions of cloud centers or reasonably well defined surface points. The manuscript represents a projection of these points on a horizontal "back" plane of reference at, say, 150km elevation.

3. A three-inch circular screen is adjustable in height and slides above the manuscript so its center, containing a reference mark, may be placed directly above one of the points referred to above. The height is adjusted to conform to the actual determined elevation of the cloud position.

4. The projectors are individually adjusted above their known manuscript positions to recover the original camera orientations, maintaining the condition that projection of the vertical photo coordinate axis (extended) pass through the plotted manuscript position for that camera.

5. The platen is removed, and the cloud outlines are projected onto the "back" plane and traced. This is done for all the camera-projectors.

6. The manuscript and the projected perspective outlines are enlarged to a convenient model scale and transferred to the flat surface of an 8″ x 16″ x 24″ block of Styrofoam.

7. The block is oriented in an apparatus in which the original rays producing the cloud outline perspective are swept out by a taut wire, which rotates about one end, representing the fixed camera position. The wire melts and cuts the Styrofoam, outlining a projective envelope in the Styrofoam. Each envelope is tangent to every other envelope at two or more limiting points on the cloud. The raw model is the piece of Styrofoam contained within both envelopes. More envelopes reduce the size of the piece and the uncertainty of the actual cloud position in it. What is certain is that the real cloud is tangent at some point to each generating ray in each projective cone. The final model must be obtained by a rounding off of the facets to obtain a most probable cloud shape.

The above has been done for a limited number of clouds and the resulting models are presently undergoing evaluation.

— DANIEL R. SCHURZ

unusual students

continued from page 52

in an office area beneath one of the dining facilities. The darkroom was designed with an inner darkroom in which the films are tank developed and in which the first steps of the print process are carried out. The process is completed in an outer room.

The entire area can be darkened if desired, and there is an electric sliding door light lock which permits entry at any time from the outside hall. The darkroom, in the process of being completed, will include a densitometer, large light table, and the usual color enlarging and contact printing equipment. A drum dryer with a special surface will also be included for ferrotyping the sensitive color prints. The darkroom has been built and outfitted almost entirely by students, and we expect it to be in operation soon. □

65 · 105 · 180

new formula for getting the most out of a twin-lens reflex

Lens interchangeability provides the Mamiya C2 user with a freedom of lens choice offered by no other twin-lens reflex. And because of it, some very startling discoveries have been made which seem to show a trend away from the traditional 75mm or 80mm 'normal' lens. One professional C2 user puts it this way:

"Using the 105mm as a 'normal' lens instead of the 80, I have the advantage of a longer focal length—a slightly larger image and better perspective for close-ups and portraiture.

"Also, I find that I can handle just about everything with only two additional lenses. The 65mm gives me a considerably wider angle than the 105, and it also lets me focus to 4 inches without attachments. The 180mm lens covers all my telephoto needs. This lens has always been a favorite of mine, for close-cropped portraits, sports, industrials and long-distance shots."

The 65, 105 and 180mm lens complement is evidently becoming a very popular lens combination for the Mamiya C2—especially among the professionals. And it is interesting to note how many more C2 cameras are now being sold with 105mm lenses.

Whatever lens preferences you may have, if you want a twin-lens reflex that can give you close-ups without attachments, interchangeable wide angle, normal and telephotography, examine the Mamiya C2. It's the world's most versatile twin-lens reflex—the only twin-lens reflex with interchangeable lenses. See it at your dealer today. For further details, write to Dept. IP-11.

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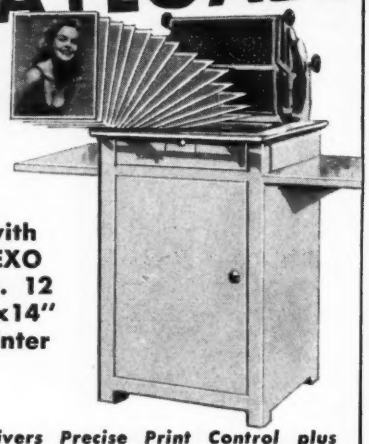

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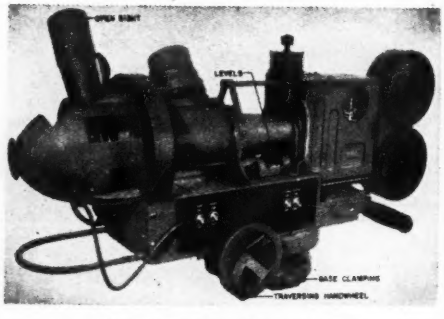

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Records simultaneously, on 35-mm. motion-picture film, the horizontal, vertical, and time co-ordinates of a moving object. This can be done to an accuracy of better than 30 seconds of arc and 1/10 second in time.

The objective is a 12″-focal-length f/5.0 Goerz lens. The cine camera's speed is continuously variable from 10 to 20 frames per second; its magazine holds a 200-foot reel. Tracking is by an 8 x 50 telescope.

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IN-PLANT OFFSET

by DANIEL G. WEBSTER
Massachusetts Institute of Technology

At M.I.T., the university's in-plant offset printing is done by the Photographic Service. It went into the printing business in 1946 when it acquired a 10 x 15 press on which to print jobs that for security reasons could not leave the premises.

Since then this printing operation has grown in all ways. The 300 square feet originally allotted for it has been expanded to 15,000 square feet. It has grown from a one-man shop to a 23-man unit.

Today, it supplies anywhere from one-third to one-half of the university's annual printing requirements. Only equipment limitations prevent it from supplying more.

Progress reports and student notes, in that order, account for the largest part of the unit's work. In addition, it produces forms, exam papers, brochures, announcements, posters and theses — in one, two or three colors.

Copy comes into the printing plant in many forms. It might arrive ready for the presses; i.e., typed with an IBM typewriter on direct image paper masters. But more often it will have to go before the unit's 24-inch Graphic Arts Camera as the first step in the conventional plate-making process.

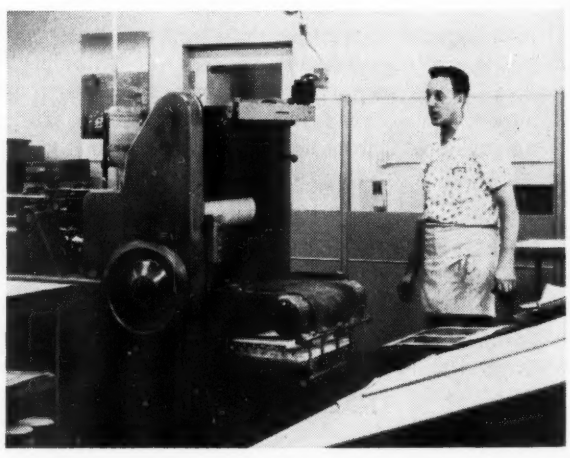
To increase negative production, an automatic roll film graphic arts camera is on order. Both are a far cry from the days when the unit had to improvise negatives on the Photostat camera and an 11 x 14 commercial camera.

Plates are also made by the electrostatic method on a 9 x 14 Xerox Office Copier, printed 1:1 from original copy. We have even used plates made by a computer.

The plant's pressroom houses three single 10 x 15 Multiliths, a tandem 10 x 15 and two 18 x 24 Chief 24s. Jobs are assigned to them according to availability.

The average job is on press only an hour or an hour-and-a-half. Runs in the 100 to 1000 range predominate. Runs of 40,000 have been made but are unusual. Runs must be short because the unit handles more than a 100 orders a week.

The advantage of having a printing plant as part of an overall Photographic Service is illustrated by an upcoming job. We are producing a book containing pictures of all faculty members. The entire job, from the making of the portraits to the finished printing, will be done in-plant. □



Most of M.I.T.'s printers have been trained in the M.I.T. plant in M.I.T. methods.

quiet revolution

continued from page 57

To date, 52 films have been released as part of the formal program. In addition, six films in the area of fluid mechanics have been produced, and a pilot project in elementary math has gone before the cameras. The latter involved three cameras shooting ad lib classes.

At present, the unit is averaging two 20 or 30-minute films a month. An average of 100 prints is made of each. They are distributed through Modern Learning Aids, a division of Modern Talking Pictures.

The movies are divided into two types: a core group of films and support films. The former are illustrated textbook material. The latter are designed to explore more of the matter taught by professional scientists, and to convey this information with the interest, taste and excitement of people whose lives are dedicated to physics.

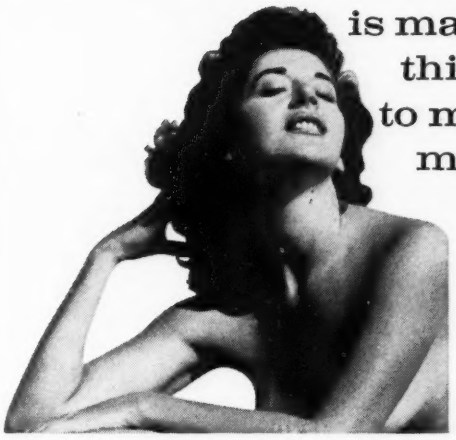
The films strike a balance between the traditional concept of a teaching film and pictorial values that attract and stimulate students and teachers alike. They are more interesting than the usual education film, but also more informative than the entertainment film.

The first film in the series established the tone desired. It was a demonstration of the pressure exerted by a beam of light. This is a phenomenon which, before the making of the film, only a few score people in all the world had ever seen demonstrated. Certainly it was an experiment too difficult and too expensive to reproduce in a high school laboratory.

The scripts — which complement subjects in the curriculum's new textbook — are planned not only by educators but by leading physicists associated with university and industrial laboratories across the country. For example, a film discussing and illustrating the growth of crystals was written

continued on page 65

MIRANDA



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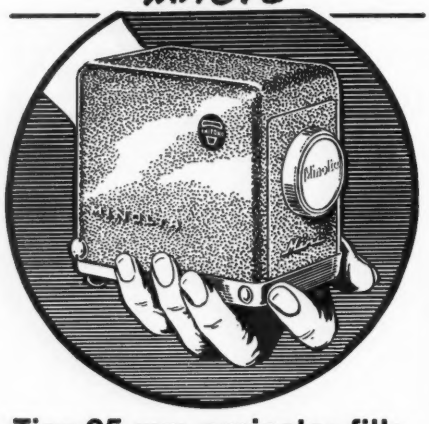

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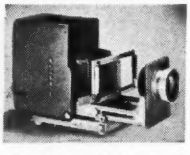

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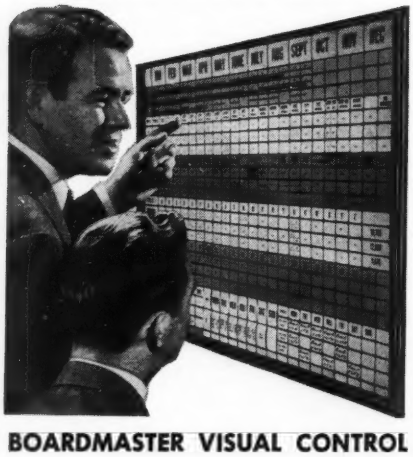

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CRYSTAL GAZING

Crystals—substances in which the atoms are so arranged as to form a pattern which repeats itself in space, more or less regularly—are a subject of study in six departments of the Massachusetts Institute of Technology: the Departments of Electrical Engineering, Biology, Geology, Metallurgy, Chemistry and Physics. In every department, the crystallographer's major guide to knowledge about crystals is the X-ray.

The crystallographer wants to study a crystal's atomic pattern. Not only the fundamental arrangement but the way in which the crystal grains are put together must be taken into account. Nor are the atoms stationary; they vibrate continuously about their average positions, and their vibrations are related to the temperature and strength of the material.

These properties are studied by means of X-ray photographs. A narrow cylindrical beam of X-rays is allowed to impinge on a small crystal, varying from one or two millimeters down to one-tenth of a millimeter in size, and the regular arrangement of atoms within the crystal diffracts the X-rays to give a pattern of spots or lines on a photographic film placed a few centimeters away. The intensities of the spots or lines, their positions and their shapes, can be made to yield information about the size and shape of the fundamental unit of pattern, the kinds and arrangements of atoms present and the ways in which they are moving. A variety of special cameras are used in these studies.

Perhaps the most profound work in M.I.T. crystallography is being done by Prof. Alex Rich of the Dept. of Biology. He is involved in solving the ultimate mystery — life itself. Specifically, he is engaged in probing how heredity works.

CRYSTAL INVESTIGATION is among research techniques employed by M.I.T. departments utilizing X-ray photographs.

It appears that an acid within our chromosomes — deoxyribonucleic acid — is the punched card of our lives. It directs the destiny of cells to be formed, tells when and where and in what order the growth of life should proceed.

Prof. Rich is helping biologists find out more about DNA by applying his specialty. He has been shooting X-rays into DNA molecules and studying the scatter figure pattern that results on photographic film. Known dispersal diagrams disclose much about the makeup of the molecules and the pattern in which the atoms are arranged.

Crystals, as semiconductors, are essential to modern electronics. Without germanium, for example, that most important of post-World War II devices, the transistor, could not exist. Unfortunately, from cost, quality and quantity standpoints, technicians cannot depend solely upon nature for their supply of crystals, so they have taken to "growing" their own. M.I.T. crystallographers are much involved in this phase of the art. — J.H. □

quiet revolution

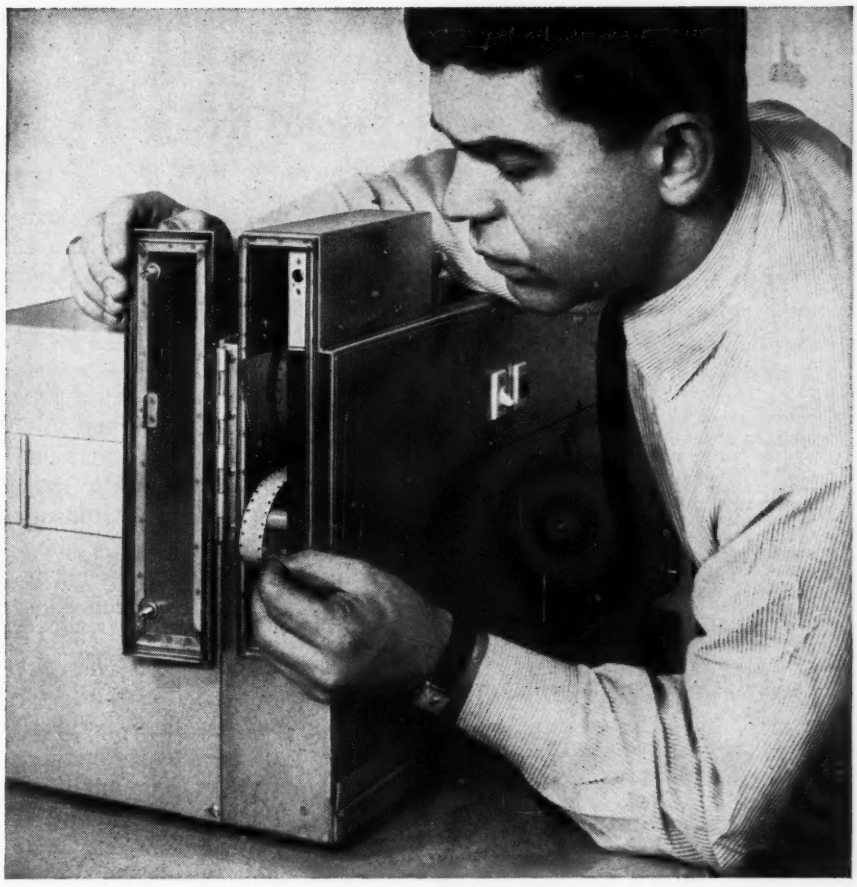
continued from page 63

and narrated by Alan Holden of the Bell Telephone Laboratories. It was filmed right in his laboratory in Summit, N.J. It is this control of the content by the people who best know it that is most responsible for the success of these films.

The professional moviemakers derive their satisfactions by using their cinematographic ingenuity to help the scientists make their points. In the film "Frames of Reference" an effect called for a scientist hanging by his knees from a bar to suddenly turn right side up. To accomplish this the Mitchell 35 was mounted in a specially built cradle that could be rotated 180 degrees. In the same movie a set was spun on a turntable to demonstrate rotating frames of reference.

Not only individuals in industry but entire companies are called upon for cooperation in the making of films. Typical of such films is one made with the cooperation of New England Electric's Salem Harbor Station to demonstrate the conversion of energy from thermal form to mechanical and back to thermal by use of an electric generating station. It was shot in two weeks on location. New England Electric engineers handled the narration and New England Electric crews were the actors. The utility itself has acquired prints of this 30-minute film for use in student recruiting programs, engineering meetings and general public relations projects. (Fifty per cent of film sales are to organizations outside the formal program.)

These films have opened a new frontier in education. By making skilled use of the motion picture, the influence of the best-informed professors is multiplied many times. Instead of reaching a handful of students, the physicist reaches out to classrooms all over the country. All that is required to extend his influence even further is to make additional prints of a film. — J. HUGHES



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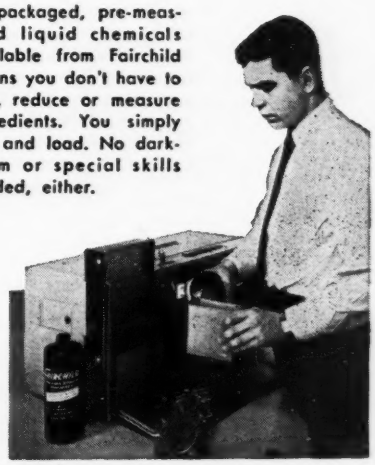

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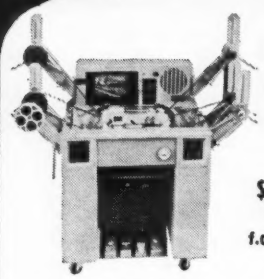

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visual arts

continued from page 39

As they play with light, preserving its transient effects on film or paper, their intuitive senses about design open up and take their proper place. The foreign world of design begins to make sense.

In a darkroom creating a photogram, or in the workshop solving a problem in dominance and recession of black to white tones of the gray scale, the student's new language is vision. Photography provides the means for developing abilities to visualize and pre-visualize.

For the architects and city planners, experience with the photographic medium awakens them to the demand for more than comfort and amplitude in lighting. Photography acts as an interpreter of the light that clarifies their achitectural spaces. And, in all honesty, these courses offer the best chance, at the best time, for the professional architects to learn about photography and its applications in design.

Most of the students have had no background or formal training in photography. They pick up the necessary know-how as the particular object or problem requires. The end result, on the whole, doesn't lack in technique. With the aid of an expert darkroom technician who is on hand, a student of technical mind with previous laboratory training can arrive at good techniques, essential to the execution of their projects.

Ideally, the goal of the visual arts program at M.I.T. is "to develop the capacity of the technician to undertake responsibility for the forms that his technical training creates . . ." The more immediate effect of the program has already been evidenced by the quality of work from students of all specializations and the seriousness they invest in visual problems.

This past summer in Italy, Professor Kepes — on behalf of the Visual Arts program, School of Architecture — accepted the Grand International Prize La Rinascente Compasso d'Oro, awarded annually to an institution for its total contribution in visual arts and education. Previous recipients have included the Museum of Modern Art in New York. Part of the Award will be the publication of a book containing reproductions of visual design by M.I.T. students and faculty.

So, for that man who thinks that the scientist-engineer can be blinded by his own specialization, we report that, with the aid of numerous improvisations on the photographic medium, Tech men are voluntarily submitting themselves to a variety of eye-openers and responding imaginatively to visual opportunities. □

photogrammetry

continued from page 35

at the corner of the two legs. Sixteen millimeter color records are also made at this site, where a master intervalometer controls the two remote cameras (via rented telephone lines), and where High Cue weather scanning radar is also located.

Since the rotating vertical-scan radar yields cloud data which, in fact, has the same perspective as does photographic data, the coincidence of sites allows the detailed and comprehensive photographic data from the cloud surface to be directly correlated with radar data which shows vertical slices of the cloud interior. Radar-tracked aircraft probe cloud interiors and U-2 weather research planes supply aerial panoramic photographs and data for further correlation.

Because of the remoteness of camera sites from one another, the camera mountings have been built to rotate into a given direction with a minimum of time and adjustment if unexpected cloud developments are to be caught from their early stages onward.

The T-11 camera sits on a mount capable of 360 degrees

horizontal rotation and minus 5 degrees to plus 35 degrees vertical rotation. The camera axis and the cross-photo axis can be leveled within plus or minus two minutes of the horiztonal. Horizontal angular settings are made by adjusting to one of several pre-calibrated directional settings. The directional settings for the three cameras are the same, so that the camera axes remain parallel when rotated to corresponding settings.

Wide-angle systems solve problems of cloud extent. The 9″ x 9″ format, wideangle T-11 mapping cameras give a horizontal coverage of 74 degrees. It is most practical for viewing and analysis to keep the cameras in a horizontal attitude, so vertical coverage is restricted under this condition to 37 degrees. Aerial panoramic cameras, when mounted horizontally, can span 180 degrees of the horizon.

Camera settings are accurate to within six minutes of arc and may be reproduced within approximately plus or minus two minutes of arc. Settings are made by means of a metal-set mounted on the horizontal bearing, and are recovered by rotating the mount until the set reseats in its original indentation.

The three capstan jacks supporting the camera mount may be permanently adjusted so that the camera tilts less than two minutes of arc during a full 360 degrees rotation.

In addition to the directional pre-calibration and regular bubble readings, selected photos from each camera station are post-calibrated, using well-defined distant ground points. This way, level-bubble errors can be checked and horizontal calibrations performed to one minute accuracy.

The metrical criteria for these studies is to place cloud segments accurately within plus or minus 1000 feet of true plan position and within plus or minus 500 feet of true elevation. These represent fine positioning on a meteorological scale of reference.

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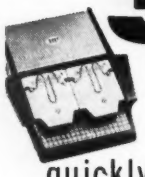
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Moreover, vector velocity data is desired which is accurate to within 10-15 miles per hour. The accuracy achievable must, of course, drop as distance increases; in fact, in proportion to distance squared.

For precision in vector velocity measurement, it is more important to make precise measurements of *relative* cloud positions in *successive* photos—rather than of absolute positions. Measurements of sufficient accuracy can be obtained using a stereocomparator. Up to the present, however, the high cost and the difficulties of using this type of equipment has made this alternative impractical. Ingenious use of simpler stereo and scalar measuring devices has, therefore, been necessary. The stereo viewing principle, in conjunction with a stereometer, has been employed to measure photo parallaxes, which are the effect of image movement in both photo coordinate directions. Successive photos from the same camera station are oriented under the stereometer and relative movements measured to 0.01mm. Fixed ground imagery provides reference points.

Measurements in depth affect the calculation of all image coordinates. Depth measurements are primarily made using depth parallax (the difference in horizontal image coordinates from two cameras). This is combined with scalar measurements made relative to the photo fiducial axes to compute the absolute cloud position.

The assumption that photo axes are parallel is critical; consequently, cloud positions are computed using all the level-bubble and post-calibration data. This is accomplished through use of several matrix rotations of coordinate systems and has been programmed for the IBM 650 computer. The program also "fits" the image movement parallax readings between the absolute scalar readings, which are only read every few photos, and adjusts discrepancies.

The output of the computations are the State Plane Coordinates of the specific cloud points measured at different times, the vector velocity components of the cloud points, the horizontal velocity and azimuth, and vertical acceleration. A "smoothing" routine is utilized to reduce small irregularities due to random errors in the measuring of parallaxes.

The greatest precision is attained when both scalar and depth parallax readings are referred to well-defined horizon points. However, such points are not always present and sometimes are obscured by deep shadow.

Linear Glass Scales

Linear glass scales interpolating to 0.05 and 0.01mm can be used for scalar readings. A 5mm overlay grid (made on 0.07" Mylar from master glass grid plates) appears, however, to have significant advantages in precision and efficiency of use. Readings are made by superimposing a 20mm reticle, with 7X magnification, over the grid and shifting eye position until reticle and grid appear aligned.

The variation in film and print shrinkage, as well as polarization of shrinkage effects, must also be accounted for in the computational process. Fortunately, this is simplified with T-11 cameras by fiducial marks along both photo axes. The distances between the marks are known. Measurements of these distances are made on each photo, and their values are entered into the data reduction program.

Stereo-Cine Scanning

Another phase of the project is the development of a 35mm camera system for stereo-cine scanning and cloud measurement. For cloud study, time-lapse photography in cine-motion has the advantage of reporting in 3-D the *continuous* movement of formations. Measurements then are not dissociated from continu-

ity of cloud development. The realization of a 35mm comparator device is still in an early stage, but it is hopeful that a prototype will be operational before 1962 and can then be evaluated against existing and proposed 35mm stereo photography.

To date, time-lapse films have been exposed at five and 10-second intervals, resulting in a compression in time of 100 to 200X at normal projection speeds.

T-11 photography makes use of 10″ x 400′ rolls of aerographic film. Cameras are set at a fixed f/8 with a #25 deep red filter. Shutter speeds of about 1/300 were suitable for picking up good detail over the full range of cloud brightness in the Flagstaff area (7,000′). Nine-inch-square photos are taken at a rate of one or two per minute.

Prints for measurement are made from Resisto Rapid and Sonne strip paper. Mylar-based films are used if costs allow.

Image Contrast

Of note is the problem of increasing image contrast gradients without reducing print range to the point where shadowed ground reference points are indistinguishable. This is a problem with both vertical and terrestrial photography. If carefully handled, unsharp masks were found to be a satisfactory technical answer to the problem, but at the same time proved too expensive and inefficient for use in quantity production.

Electronic dodging, upon investigation, was found to give excellent results with a high bias setting. In quantity production, though, the drawback of electronic dodging is in the long exposure needed for proper dodging of pictures with major cloud shadow.

The ideal texture for stereometric work is considered to be a gray, solid-appearing cloud, with black shadow fringes and bright highlight fringes; i.e., maximum surface contrast within practical limits. □

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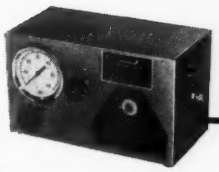

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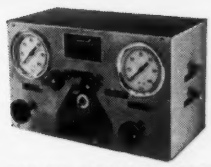

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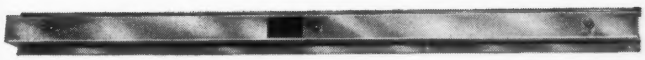

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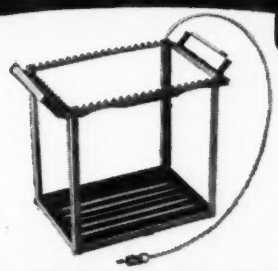

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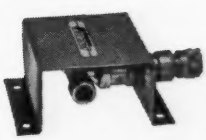

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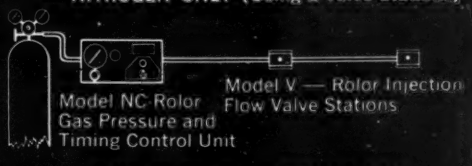

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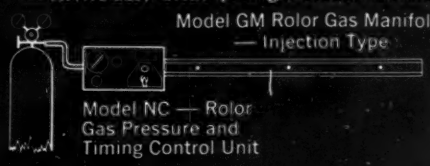

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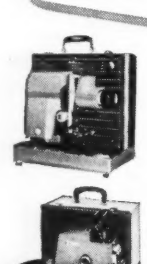

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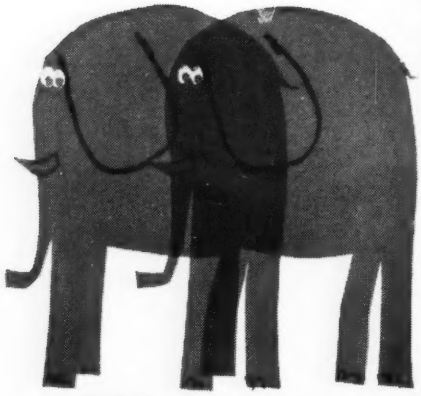

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photo service

continued from page 33

tery of various types and sizes of enlargers, ranging from 35mm to 8 x 10. On a third wall are trimming benches and stock shelves.

An island-type sink in the center of the room enables four men to work simultaneously. Final prints are fed off one end of the sink, through fixing solutions, and ultimately into two rotary washing machines that protrude through the fourth wall of the room. When washing time is completed, finishers on the light side of the wall retrieve the prints and put them through the matte or gloss dryers, trimmers, etc.

The whiteprinting and Photostat operations have been combined in one area. A 42-inch Ozalid diazo machine turns out engineering and architectural drawings, student theses and reports requiring only a few copies.

The 11 x 14 and 18 x 24 Photostat cameras are also used for theses, as well as for copying records and documents. They are darkroom operation units. All prints are automatically exposed but developed by hand. Ordinarily, one man can handle the department's normal Photostat business. But, if necessary, a cameraman working outside can feed the prints for processing to a man in the darkroom.

Also in this area is a 9 x 14 Xerox printer, which is being used experimentally to make plates for the offset printing department.

All in all, there are 12 darkrooms in the facility, all scientifically arranged and modernly equipped. Their light locks are perhaps their most striking features. Instead of passing through doors, the visitor gains entrance to a darkroom by walking through an "S"-shaped passage two feet wide painted dull black. This blocks the light from the outside but permits a constant stream of fresh air to carry away chemical odors from the developing process. These light locks have been commended by Eastman Kodak.

In addition to the studios and D & P rooms described, there is a chemical mixing room. All photographic processing chemicals are located there. Only mixed solutions are carried into the various darkrooms. This allows a standard of cleanliness not possible when darkrooms are also mixing areas.

There is a general stock room where materials are stored and drawn on request through the photographic supervisor, Robert K. Ashworth. This procedure minimizes waste.

There are several other work areas carefully planned for efficient operation and which along with the ones already described are equipped to turn out a startling variety of photographic products.

M.I.T.'s Graphic Arts Service is a self-supporting but non-profit operation that sells its services to its University customers at prices competitive with those offered by outsiders. In its first year of operation, it did $600 worth of business; last year $400,000 worth. At its present rate of growth, it may hit the million-dollar mark in five years, at which time it will require at least 10,000 additional square feet of space.

Frank Conant and Assistant Manager Daniel G. Webster deserve most of the credit for this record of growth. They are first-rate administrators as well as being top-flight photographic technicians. This strikes you the moment you walk into the lobby of their neat, attractive, streamlined plant. There, on the ground floor, is a control board, the nerve center of the operation, which at all times shows who of the department is where and doing what — in the plant, on the campus or out of town. It strikes you if you are looking for a nine-year-old negative and see how quickly it is located in the department's efficient negative file. This business-like approach carries through the whole operation, assuring efficient service for customers and efficient

use of employees' time. Production records are kept not only by the day but by the hour as well.

Frank Conant believes that his job is to provide M.I.T. with the best possible photographic service at the lowest possible price. If that means going to the outside, he doesn't hesitate, whether it be for motion pictures or aerial photographs.

Despite this unselfish attitude — or probably because of it — Frank Conant's own department has continued to grow, inspiring increasing confidence on the part of the University's officials.

Without adding men and equipment just for the sake of "empire-building," Frank Conant has organized a competent and well-rounded staff — almost all trained within the plant to handle almost any photographic assignment. Their cameras range from an 11 x 14 Eastman studio camera through 5 x 7 Linhofs to a variety of 35mm stills. In their studios they can call on strobe or incandescent lighting.

Each year Photographic Service makes available to M.I.T.'s instructing staff identification pictures of *all* undergraduate students and, in certain departments, graduate students.

This student picture program was started 10 years ago as the answer to a problem caused by the growth of the university. Professors aren't really absent-minded, but the increasing number of students in classes was making it difficult for the instructors to associate hundreds of names and faces.

In terms of volume, this is the biggest job that Photographic Service has to do all year. During the registration period, when this project is pursued, labs are humming night and day.

Each student, as he passes through the registration line, comes before a semi-automatic 35mm camera, developed for just this massive project. Portronic elements (magazine and stand) are integral parts of this custom camera.

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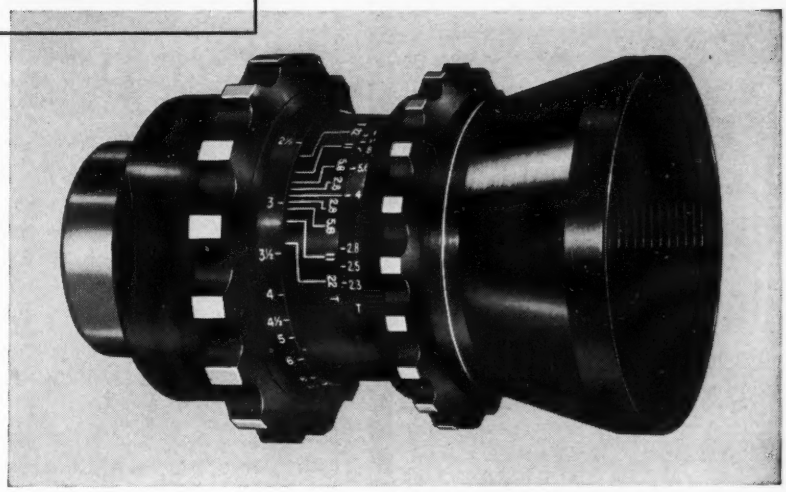

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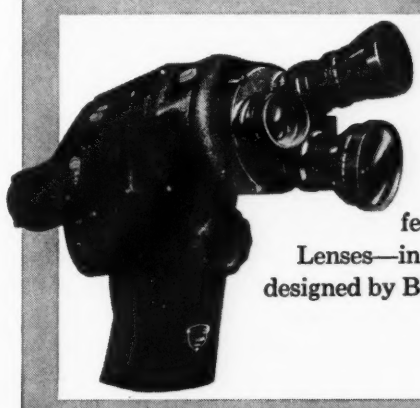

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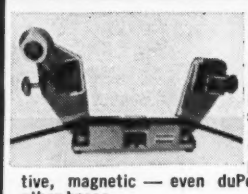

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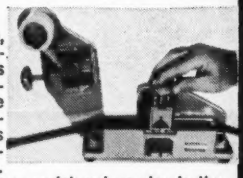
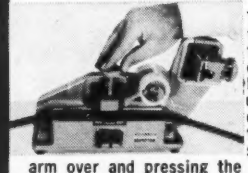


The cutting arm, shown in operating position, is used by pressing the chrome button for cutting both sides of the film simultaneously. The film, has been registered on pins in the horizontal channel. The cutting blade is easily replaced.



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At the end of a day's shooting, the camera crew will have photographed approximately 1,000 students. And at the end of five days, Photographic Service will have delivered a complete set of first year student pictures in alphabetic file to the First Year Headquarters of the Chemistry, Physics, Humanities, Mathematics and Athletic Departments, must areas of study for all first-year students. In addition, each first year student is mailed an envelope containing two identification pictures of himself. He is instructed to turn in one picture to his instructor in each additional subject he may be taking.

Second, third and fourth-year students receive 10 identification pictures when they register. They turn in one picture to each of their instructors at the first recitation period in each subject.

Each instructor is provided with a special loose-leaf notebook with pre-cut pages, which allow the pictures of the students to be corner-mounted in accordance with the seating arrangement in each class. Cellophane or acetate jackets protect the pictures on the pages.

Each time an instructor holds a class he can have spread before him this identification device, giving the name and picture of each student in his proper place in the room, until he has had time to memorize them.

A hundred prints are made of each student. The average student will use up to 10 prints per term, 20 prints per year. Some students take a five-year course, so you can readily see that the student picture program is a big job for the Photographic Service Department. □

a-v workshop

continued from page 18

"Now, the original copy is exposed through the microreproduction camera onto 35mm film, and a quantity of exposures are processed at one time in an automatic 35mm processor.

"All right so far, but in developing the new technique, the next production step led to our first bottleneck: how to project the small 35mm images to the right size on standard lantern slide plates. We broke this bottleneck by adapting a specially designed 35mm enlarging head to a standard enlarger stand; thereby enabling us to continue using the original 35mm negative in its roll form through the enlarging head, projecting one image at a time onto 70mm roll film for the ultimate image. After a reasonable number of exposures have been made in this manner, the film is removed from its magazine and put through automatic processing once again for the end positive result.

Final Bottleneck

"We are now faced with our final bottleneck, which we are working on and hope to break in the immediate future. After cutting the negatives apart, we are still faced with finishing them in the old conventional manner of hand-selecting masks and applying them to the particular subject matter, dusting off the surfaces of the film and making a sandwich by applying two carefully dusted cover glasses. After this, by hand, tape is applied to all edges and the corners turned in. If we can now develop a simple machine which will handle this process at least semi-automatically, I am sure that we will have achieved increased production and reduced cost without sacrificing quality." □

M.I.T.'S INSTRUMENTATION LABORATORY

Nine hundred people on the staff of M.I.T.'s Instrumentation Laboratory are working around the clock on one of the projects most vital to our nation's defense — the development of missile guidance systems. It was in this lab that the Polaris guidance system was born, as was the one for the Air Force Thor missile. It is in this lab that photography has an important support role.

A four-man staff headed by William H. Beal is responsible for the wide range of photographic processes in this laboratory. These include high-speed motion pictures of experiments and tests. They are shot with a Fastax at speeds ranging from 2,000 to 3,000 frames and are lit with special narrow-field reflector floods that give a three-inch spread at 20 inches. Conventional 16mm silent movies are also shot for internal report purposes.

Other photographic products coming out of the lab's two fully equipped darkrooms are general still shots of test procedures and set-ups in black-and-white and color; progress pictures of construction and assemblies; process camera work, both in line and screened, to be used by the publications department in the production of reports; and both positive and negative films accurately sized for printed circuit work.

Many of the pictures that Bill Beal's crew takes are ultimately used as slides. They are made in both the 2 x 2 and 3¼ x 4 size, but mostly the latter because they are better for showing detail. Incidentally, Bill thinks that engineers tend to try to put too much information on a single slide. Eight by ten Vu-graphs in both color and black-and-white are also made for those who have to report on the progress and processes of this division of the Department of Aeronautics and Astronautics. □

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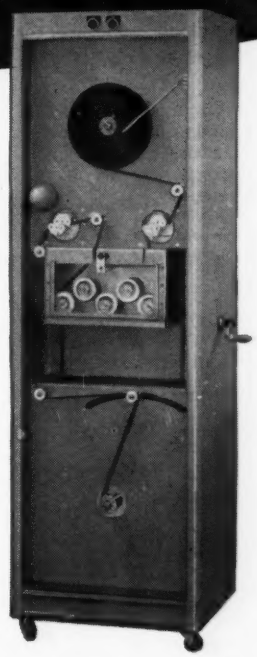

Model A-5100 combination 16/35 mm film cleaner. Other cleaners available for 16 mm film only, 35 mm film only and for 70 mm film only. Price: Model A-5100 $5,500 f.o.b. Sylmar, California.

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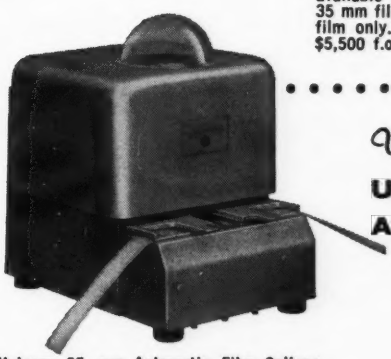

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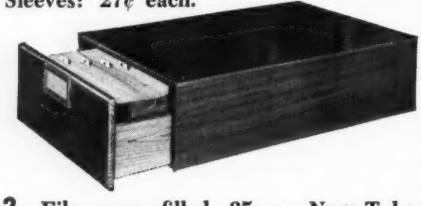

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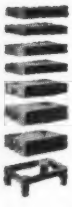

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repro manager

continued from page 19

for each exposure — for exposing each layer of emulsion. An 80B (blue) is used for the first exposure on the long scale continuous tone emulsion, and a K-2 (yellow) is used for the second exposure on the short scale high contrast emulsion. Each filter permits the desired layer of emulsion to be exposed while masking the other.

Development

Any universal type paper developer can be used such as Dektol, 53-D and Hunt-7. Dilute the developer, one part developer to one part water, and develop approximately four minutes at 68F in a tray.

A DK-50-type developer will produce results without dilution at three and one-half minutes in a tray, or six minutes in a tank, at 68F. Development should be controlled by time and temperature and should be standardized. All contrast and density changes should be made by exposure, not development. Correctone can be handled under red darkroom bulbs.

Determining Exposure:

Step No. 1 Place a continuous tone original, preferably a good black and white photograph, in the copy easel. Insert a continuous tone gray scale at the bottom of the image area.

Step. No. 2 Set the camera for a one-to-one reproduction.

Step No. 3 Position an 80B (blue) filter over the lens.

Step No. 4 Take a meter reading when using tungsten lights, using an ASA index of 1.5. For arc lamps set the lens at *f*/45.

Step No. 5 Make the first exposure with the 80B filter. The trial exposure with arc lamps will be between three and six seconds, with fluorescents two to three times longer.

Step No. 6 Develop the test according to the outlined development procedures.

Step No. 7 Inspect the negative on a light table, specifically checking the overall density level.

It may take two or three tests to determine what the basic exposure should be. Keep in mind that the best negative produced will still be slightly lower in density than a normal copy negative, but this will be controlled by the yellow light exposure. The best exposure time should be established as a standard for future copies.

The yellow light exposure, through the K-2 filter, will serve as our highlight control, either by increasing the highlights for ordinary originals, or by completely dropping out the backgrounds in art work.

To obtain "block-outs" with arc lamps, the second exposure with the yellow filter should be approximately eight times the main exposure.

If eight times is not sufficient to drop out the background try ten times, twelve times and then fifteen times the main exposure. For example: If the first or main exposure is six seconds at one-to-one, then the highlight increase will be eight times that or — forty-eight seconds with a K-2 filter. With tungsten illumination the yellow light exposure for drop-outs is only one-and-one-half to five times the main exposure.

To increase the highlights with routine originals, such as a photographic print, a four times highlight increase will usually suffice and will provide an excellent "highlight kick." With tungsten illumination a one-half to one times highlight increase will usually be adequate. Experience will provide a means of judging originals for determination of the yellow light exposure. □

"Sure, I think every man should develop a hobby. But must you develop yours on company time?"

movie clinic

continued from page 14

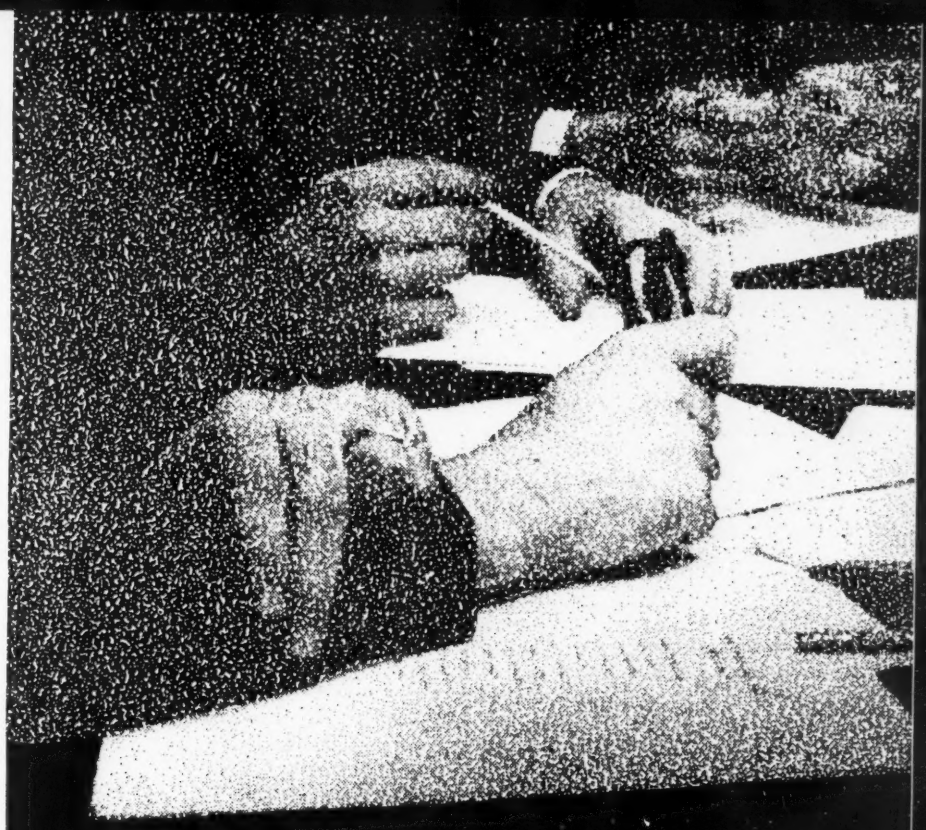
films reduced the number of lights used to illuminate a motion picture set?

A. Faster emulsions, in both black and white and color, have allowed shooting under lower available light conditions both indoors and out. While this is a boon to newsreel and documentary cameramen filming on actual locations, it has not affected lighting techniques in the studio. The same number of lighting units are required to achieve a desired effect. Every light used on a studio set has a purpose — it is not used merely to provide additional illumination. The key, fill, kicker, back-cross, eye light, etc., are all used for a definite purpose and to aid in creating a predetermined lighting effect. Professional cameramen are making use of the increased film speed by using lower wattage bulbs, to lower the overall lighting level, or they are working at reduced apertures for increased depth of field. The smaller f/stop simplifies "follow-focusing" (in which the focus is altered as the subject or the camera moves above the set) and also makes easier the filming of dolly shoots or other moving shots where focusing is critical.

Got a movie question? Send it to Walter Strenge c/o IP Movie Clinic, P.O. Box 985, Hollywood 28, Calif. All questions will be answered and those with wide interest will be reprinted in this column.

Q. ***What is meant by a "field" in animation?***

A. An animation "field" is a unit used to define the boundaries of the cel area actually photographed. Although animation field dimensions may be arbitrary most of the industry uses the Acme system which defines a field unit as being one inch in width. Any field number then becomes a multiple of one: a 12 field, for instance, would be 12 inches wide. Animation cameras are calibrated in reference to field units so that the desired area may be filmed precisely without the necessity of time-consuming line-up work. □



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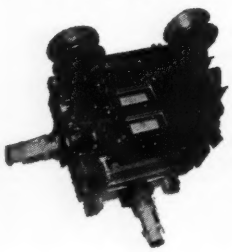

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european

continued from page 20

management, other photographers, and the lay public—turning against him (non-conformity is a social *faux pas*). Parallel photographs would be necessary — one to please management, the other the photographer. But in time even the toughest barricades have been known to crumble — and with their removal a new respect and status for the photographer is born.

This philosophy, which pervades Fritz Brill's whole attitude to publicity photography, is by no means new. It has roots in pre-war Bauhaus teaching — a school of architectural design. What is original is Brill's extension of its principles into the field of photoanalysis. Higher productivity, improved product standards, and research into recently evolved materials have called for new photographic aids. Since the war the Fritz Brill studios and labs at Hofgeismar have been tackling a growing volume of advanced high speed and time lapse cinematography, photomicrography and other analytical techniques.

With typical German thoroughness and hard work, Brill approaches every assignment with as unbiased a mind as possible. If apparatus is not available he makes it; anything from a multi-thousand volt transformer to an endoscope. A typical example is his now famous 'Baking Cake' time lapse sequence, as exhibited at Photokina.

Having carefully studied the effect of a certain baking powder during the cooking of a cake Brill built himself a 'photographic oven'. This contained I-R heating elements, and incorporated glass 'portholes' on each side for illuminating the interior and an optical glass aperture in the top for the vertically mounted time lapse camera. Steam misting up the camera aperture provided the first problem. It was cured by pumping air through the oven, air which had to be preheated to avoid temperature fluctuations.

Secondly, since only a small area of the surface of the cake mixture

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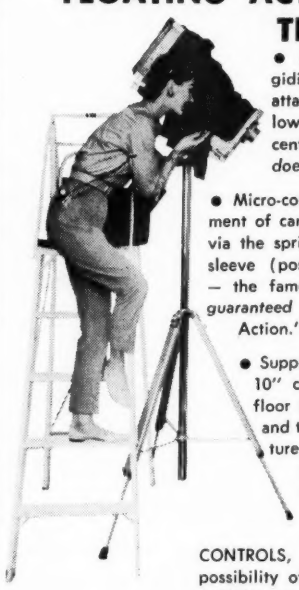

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was to be recorded, depth of field was a matter of only a few mms. During cooking the top began to 'rise' and it proved impossible to effectively pull the focus. A sensitive rocker arm was therefore left resting on the surface of the mix, which tripped a micro switch as the cake 'rose'. This operated an electric lift on which the cake tin was resting, lowering the whole cake and thus continually maintaining its top surface in the plane of sharp focus.

All these components were handmade, and illustrate Brill's relentless acquisition of the means to achieve a clear cut end. Having prefaced all his work by a fundamental 'coming to terms' with his subject —be it the scientific basis of a phenomena or fundamental nature of a product — the comparatively unimportant remainder of the assignment, the making of a visible image on film, is purely a question of time.

Sometime, on those black days when photography seems tasteless and altogether too mechanical, one's own reassessment of fundamental values can give new purpose for being a photographer in industry. □

instrumentation

continued from page 22

desired instant to catch the action is often the most difficult task in high-speed photography. Various methods involving electrical contacts, microphones or phototubes are employed, depending upon the problem at hand.

"Some of the factors that influence the flash duration are (1) the resonant frequency of the energy storage capacitor and the entire discharge circuit including the inductance in the capacitor; (2) the effective resistance of the entire discharge circuit including the lamp; and (3) the afterglow in the gas after the current has ceased to exist.

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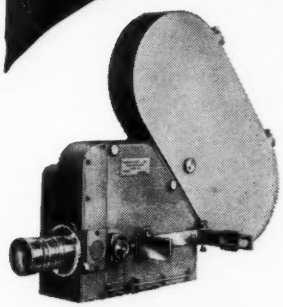

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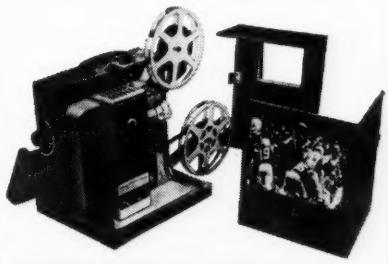

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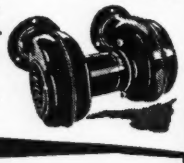

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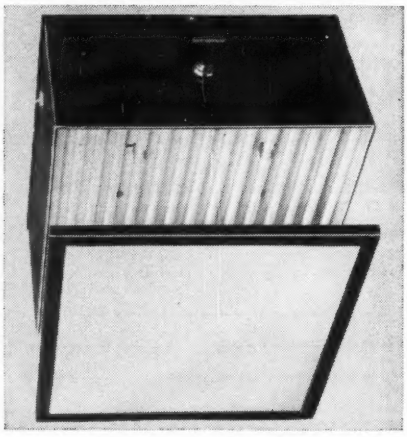

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"Low-energy sparks are influenced by the nonlinear effects of the spark gap. A series of experiments was made to find the effective resistance as a function of air-gap length and frequency for a capacitor of about 100 $\mu\mu$f. An EG&G Traveling-Wave Oscillograph, Type 2236, was used to record the frequency and attentuation of the flux coupled into a small search coil near the discharge circuit.

"A mica-insulated doughnut capacitor of 130 $\mu\mu$f was mounted in a pressure cylinder so that the effects of different gases and pressures could be studied. The light was observed through a Plexiglas window by a 929 phototube (S-4 surface) with 2500 v on the plate. The signal current was connected to an RG-8U coaxial cable and a delay line before being connected to the plates of an EG&G Traveling-Wave Oscillograph." □

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The photographic needs of M.I.T.'s Research Laboratory of Electronics are provided by Benjamin J. Diver and an assistant. They work exclusively for this lab, whose director, Dr. Jerome B. Wiesner is President Kennedy's chief scientific adviser.

This two-man department photographs various types of equipment, components and line drawings for quarterly progress reports and technical reports. Occasionally, they are called upon to make X-ray photographs of trouble spots in components. Also, they make slides for lectures or meetings. □

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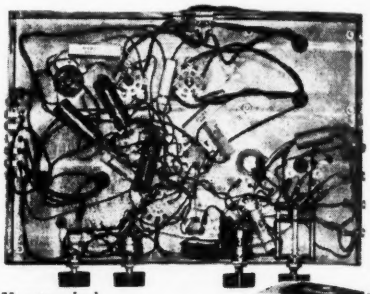

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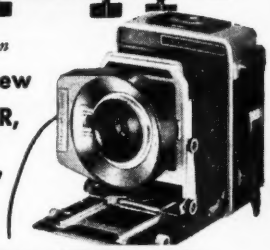

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new products

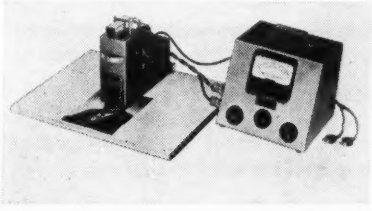
continued from page 12

Multi Format I. D. Camera 104

An identification camera providing a choice of six different formats has been announced by the Industrial Products Division of *Fairchild Camera and Instrument Corp.* The Fairchild-Polaroid F-430 can be set to make four identical pictures of one subject, two pair of two different persons, front and profile of one person, head only, and front and profile of one person, ¾ body. Four different poses of one person as well as individual photos of four subjects may also be made with the camera. The system is designed to produce I. D. badges and uses regular Polaroid-Land 10 second film. Standard equipment includes the camera, wink light, tripod, positioning bar panel, numbers and Portra lens. Shutter speeds are from one second to 1/25 second. The camera features a 90mm *f*/3.5 lens mounted in Alphax shutter. Price: $605.

Photo Electric Meter 105

A versatile measuring instrument for determining densities by reflection or transmission and for light measurements of small areas is being offered by the *Photovolt Corporation.*



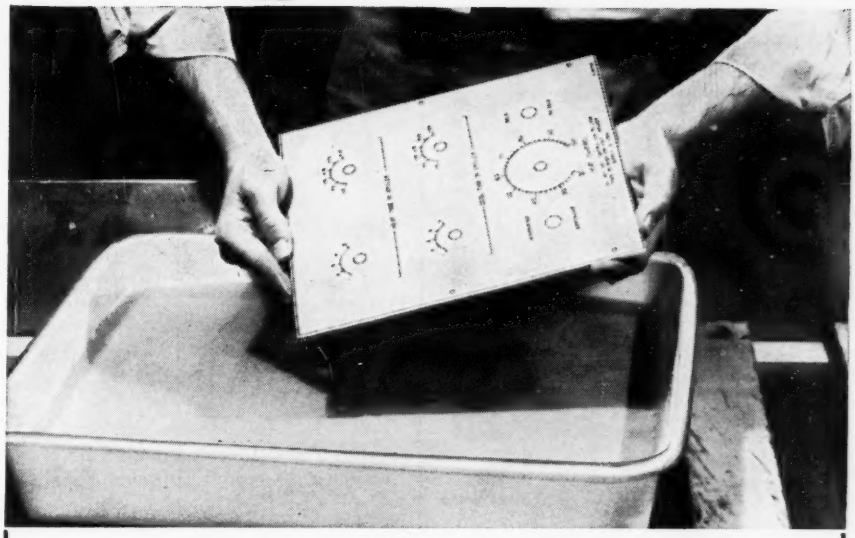
The unit consists of three parts: a transmission density unit, model 52; a reflection density unit, model 53; and an electronic spot-photometer, model 501-A. Individual components can be purchased separately. Heart of the system is the spot-photometer whose search head is interchangeably connected to the instrument by a twin cable with plug connections. Response of the photo-emissive type tube approximates the color sensitivity of commonly used emulsions.

Typical applications of the Model 5123 consists of determining density contrast, sensitometric readings of films and printing papers, balancing of color separation negatives, and reading color densities on color negatives. A series of accessories such as filterturret neutral density filters and special search heads are available.

High Speed Stereo Camera 106

High speed cameras are getting faster and faster and now *Benson-Lehner Corporation* has developed a

continued on page 83



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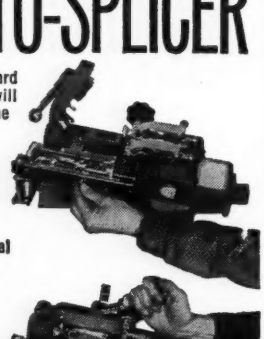
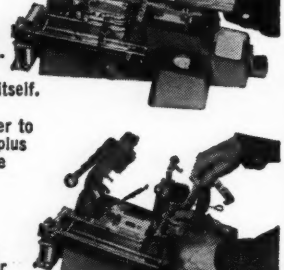
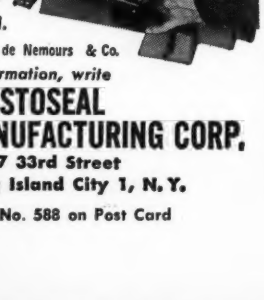


Splice in the usual manner. Heat sets the adhesive but does not disarrange the molecular structure of the tape. The bond is permanent, stronger than the film itself.



Use the trimmer to remove the surplus tape. The entire procedure is so simple, so positive, that no special training is needed for your existing personnel.



*T.M. E. I. duPont de Nemours & Co.

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new free literature

penni kimmel, editorial assistant

Keep posted on the latest developments in the photographic field. Each item listed below has a key number. For more information, circle that same number on Readers Inquiry Card.

INSTRUMENTATION

Optical Glossary 201
Servo Corporation. A comprehensive glossary of optical terminology, the first in a series of glossaries designed for instrumentation use.

Stop Motion Projector 202
Camera Equipment Co. CECO spec sheets now available for the Red Lake stop motion projector for study of recorded data.

Framing Camera 203
Beckman & Whitley. Information on the B & W framing cameras.

Photomicrography 204
Gevaert. 29-page booklet contains technical info on photomicrographic camera, illumination, resolving power and light sources.

Measuring Instruments 205
Photovolt Corp. Bulletin on instruments for general lab purposes as well as colorimetry, photometry and other specialized work.

Electron Microscope 206
Philips Electronic Instruments. 6-page folder covers features of the Norelco EM-200 electron microscope, also compares with earlier models.

CINEMATOGRAPHY

Recorder/Reproducer 207
Magnasync Corp. Literature on the Nomad, a 7-lb. recorder/reproducer for motion picture work which cannot get out of sync.

Reversal Film Processor 208
Filmline Corp. Data on the Model R 15 reversal film processor which develops film at 1200′ per hr. Also on other company products.

Service Newsletter 209
General Film Laboratories. Monthly "Rewind" discusses motion picture services and pertinent developments.

Splice and Repair 210
Florman & Babb. Info on Magic Mylar for repairing, replacing, butt splicing and strengthening overlap splices.

Reversal Printing 211
Lab-TV. Info on color printing or 16mm black and white reversal printing and processing.

Bolex Equipment 212
Paillard Inc. Info on Bolex cameras and accessories featuring Uni-motor and Super Titler.

Producer Service 213
Byron Laboratories. Illustrated brochure on organization supplying all types of lab and producer services.

Motion Picture Equipment 214
Bach Auricon. "Catalog of Ideas" shows how sound motion pictures can help profit-minded executives.

Magnetic Films 216
Minnesota Mining & Mfg. Illustrated brochure which details the varieties and qualities of Scotch brand magnetic films for the motion picture industry.

Lighting Kits 217
Natural Lighting. 8-page catalog from Colortran describes series of motion picture lighting "packages".

Grip Equipment 218
Beckett & Leonetti. Info on Century stands and arms, flags, nets, dots, flex arms, clip boards, overhead butterflies and large cutters.

Zoomar Lenses 219
Zoomar, Inc. 4-page folder of data and instructions for the Zoomar Mark IV and Mark VI ITV lenses.

Sound Techniques 220
Cine Magnetics. Monthly news letter about latest developments in magnetic film striping techniques.

Processor 221
Houston-Fearless. Complete informa-

tion about the Labmaster black-and-white processor.

EZL Titler **222**
Red Lake Laboratories. Data sheet describes new caption printer and enlarging easel for fast titling.

Duplication Charts **223**
Movielab. Two-step charts indicate methods for duplicating negative and positive color and show relative advantages of each.

Processor **226**
Oscar Fisher Co. Data on the Autotrac Processall, an automatic processor with 7-min. cycle.

DARKROOM SUPPLIES, EQUIPMENT, X-RAY

Ethol Developers **225**
Plymouth Products Co. Brochure on ethol developers for black and white film and paper processing including condensed "what to use" chart.

Background Paper **266**
Photo-Tech. Info on background paper for the photographic trade, core-wound, in 9 and 12 ft. widths.

Photocolors **227**
Webster Bros. Info on invisible colors for retouching and spotting of Ektacolor and Printon color prints.

Anhydrous Hypo Material **228**
Philip A. Hunt. Learn why this chemical is superior to rice crystals for use in film processing.

Developer/Fixer **229**
Cormac Chemical Corp. Flyer on new Unibath CC-11 for photo-typesetting, permitting processing in 90 seconds.

Enlarger **230**
Agfa. Specifications of the Agfa Varioscop 60 enlarger with automatic focusing.

Catalog and Darkroom Tips **231**
Anken. 24-page catalog includes info on Anken papers, films, emulsions, processors and chemicals.

Retouching Color Prints **232**
Eastman Kodak. Six-page folder which gives step-by-step description of various Ektacolor retouching methods.

SERVICES

Products & Services Catalog **234**
Benson-Lehner Corporation. Quick-reference folder and catalog sheets on record readers, plotters, photo instruments and services.

Color Service **235**
Kurshan & Lang. Data on color services available, including dye transfer prints, Ektacolor prints and custom color film processing.

Filmstrip and Slide Lab **236**
Manhattan Color Lab. Data on services from shooting master negatives to answer prints and slide mounting facilities.

Big Picture **237**
Republic Color. Lit on quality color prints and transparencies in all sizes and quantities; specialists in giant color work.

New Wall Chart **238**
Bebell & Bebell. Shows prices and types of all color prints including Ektachrome, Ektacolor and giant transparencies.

Film Holders and Repairs **239**
Hoffman Professional Camera. Brochure describing Hoffman equipment including film holders, bellows, slides and repair service.

Background Music **240**
Capitol Library Service. Free demonstration disc and info on Hi-Q background music.

VIEWERS, PROJECTORS, SCREENS, SLIDES

16mm Action Viewer **241**
S.O.S. Photo-Cine-Optics. Data on Ediola Action Viewers and Sound Readers.

Electric Blackboard **242**
Charles Beseler. Info on the Vugraph which projects what you write as you write it.

Portable Viewer **243**
Admaster. Lit describing portable attache case viewer for 10 x 10 overhead transparencies.

Photo Filing **244**
Multiplex. Bulletin available on photo slide filing system for orderly classification, convenience, and protection.

Desktop Audio-Visual **245**
Viewlex. Info on the Tabletalk, a self-contained combination 35mm filmstrip projector and 4-speed hi-fi in an attache case.

Versatile A-V Unit **246**
C.O.C. Info on the Master 10-10, a fully automatic rear view slide projector, slide changer and remote control unit.

Convertible Projector **247**
Spindler & Sauppe. Brochure on SL-series Selectroslides and new film strip attachment which converts projector for use with slides and film strips.

Compact Projector **248**
Richard Manufacturing. Spec sheet on the Poly-Vue filmstrip projector weighing only four lbs.

Overhead Projection **249**
Projection Optics. 7-page booklet details the 5 major advantages of the Transpaque overhead projector.

Lenticular Screens **250**
Da-Lite. Data on the 70" x 70" Wonder-Lite silver lenticular projection screens with seamless surfaces.

Why Sound-Slidefilm? **251**
DuKane Corporation. 16-page bro-

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516	535	554	573	592	611	630	650	670	690	710	730
517	536	555	574	593	612	631	651	671	691	711	731
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chure explains the advantages of the audio-visual approach to better communications.

8mm Sound Projector 252
MPO Videotronics. Folder on the new Videotronic 8, a compact 8mm sound motion picture continuous projector.

Portable Sound System 253
Kaufman & Spanier. Info on the Ampli-Vox, a self-contained unit incorporating amplifier, mike and lectern in compact carrying case.

LIGHTING

Arc Lamps 255
Strong Electric. Brochure on 95 Amp high intensity arc printing lamps including those for overhead use, with Unilight attachment and for Lanston photo composing.

Projection Lamps 256
Westinghouse Electric. 12-page guide serves as a quick reference for replacing projection lamps in motion picture and slide projectors, opaque projectors and other viewing equipment.

Reconditioning Process 257
Quartz Radiation. Details about the Nu-Life process which restores burned out mercury vapor lamps.

Photo Lamp News 258
General Electric. Tips for the photographer in the GE booklet, "What's New In Photo Lamps and Lighting".

CAMERAS, LENSES, ACCESSORIES

Color Temperature Meter 260
Kling Photo. Information on the Gossen Sixticolor which instantly shows color temperature of light source and filter required for correct balance.

Picture-in-an-Instant 261
Polaroid. Data on Type 55 P/N film pack which develops print and negative in 20 seconds outside the darkroom.

Hasselblad Camera 262
Paillard, Inc. Literature on single lens reflex Hasselblad camera with interchangeable accessories.

Superwide Lens 263
Buhl Optical Co. Details on superwide lens which cuts throw to a third of usual distance.

35mm Camera 264
Konica. Information on the new 35mm Konica camera, Model A.

35mm Reflex Camera 265
Yashica. Info on Pentamatic with interchangeable lenses, automatic stop-down diaphragm.

Portrait Camera 267
Beattie-Coleman. Details about new Imperial-90, a portrait camera which uses 3½" heavy-base roll film.

Miranda Lenses/Accessories 268
Spiratone, Inc. Brochure listing variety of lenses (28mm-400mm) and accessories including bellows units, slide duplicators and filterholders.

Location Tripod 269
Quick-Set, Inc. Introduction to the Travelin' Sam tripod kit with three-section legs and simple accessories.

GRAPHIC ARTS AND REPRODUCTION

110 Answers 271
Keuffel & Esser. Brochure provides answers to most commonly asked reproduction questions.

Blue Print Filing Equipment 272
Plan Hold Corp. Catalog outlines variety of portable equipment for blueprint, map and drawing storage.

Electronic Enlargers 273
LogEtronics. 6-page brochure gives specifications and applications for the Model B-5 and B-10 LogEtronic enlargers.

New Litho Film 274
DuPont. Bulletin on new Cronar Ortho S graphic arts film with advanced emulsion, stable base and availability in all sizes.

Vertical Camera 275
Robertson Photo-Mechanix. Bulletin on the new Meteorite Mark 1-A, spacesaving vertical camera.

Tracing Paper Characteristics 276
Charles Bruning Co. 16-page booklet covering manufacturing processes, materials selection and production of quality tracing papers.

TAPE RECORDERS

Catalog Your Tape Library 278
Ampex. Booklet on a new concept in subject identification of tape recorded material.

Tape Cleaner 279
Computer-Measurements. Info on high-speed, automatic shutoff magnetic tape cleaner, Unicorn Model T-7070.

Tape Recorders 280
National Better Business Bureau. 11-page booklet discusses the things you should know about the purchase and servicing of tape recorders.

Transistorized Tape Recorder 281
American Geloso Elec. Info on the Unicorder 61, miniature 5 lb. tape recorder with no need for AC adapter.

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MISCELLANEOUS

Heater Barney **283**
Birns & Sawyer. Brochure describes camera parka which protects in temperatures down to −60°F.

Photo Filing **284**
Nega-File Co. Info on complete filing system for all film negatives and slides with detailed suggestions on how to go about it.

Your Photo Library **285**
Macmillan Company. Catalog listing 24 books on photography and film making including the latest Focal Encyclopedia of Photography.

2-Sided Adhesive **286**
Kleen-Stik Products. Details on the new Tape Form in small dispenser package for mounting photographs.

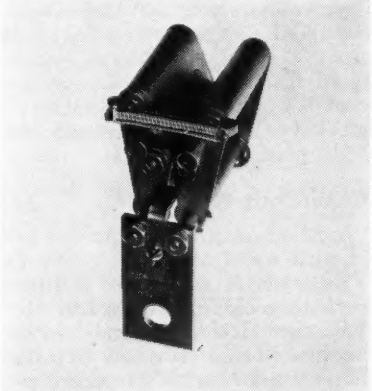
Special Effects **287**
Animation Equipment Corp. 4-page folder discusses how aerial image opticals can expedite production of effects without mattes.

new products

continued from page 79

15,000 fps camera which adds another dimension to analysis films. Called the Stereoflex Model A, the Unit is especially useful for studying the 3 dimensional nature of explosive reactions. A series of mirrors which are adjusted along a track in front of the camera are tilted to bring the desired image coverage to lenses mounted at right angles to the viewing axis of the camera. The two 16-mm images are recorded side-by-side on the single strip of 35mm film which may be shown on a specially designed projector. Acceleration time for the camera to the 15,000 fps rate is from .5 to .6 seconds yielding 300 feet of usable film out of the 400 foot roll.

Air Squeegee **107**



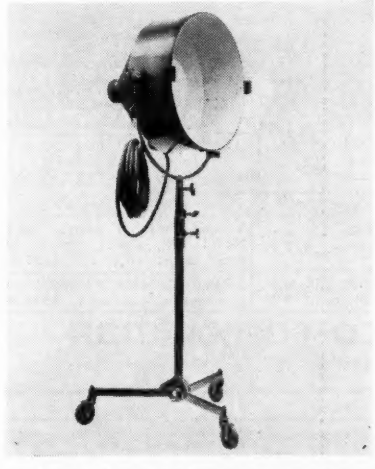
Gryphon Corporation has introduced its Model HB-2 Air Squeegee designed for use on any 16mm or 35-mm continuous processing machine. Film passes through the squeegee on an air cushion which prevents direct contact with the metal parts and the aperture opens automatically for all commonly used splices. Only two adjustments are required and these can be readily accomplished with a screwdriver and feeler gauge. The Model HB-2 is made entirely of stainless steel and can be cleaned without disassembly. Speeds in excess of 200 feet per minute yield excellent results. Price: $100.00 f.o.b. Burbank, California.

Dual Purpose Print Material **108**

A versatile material for the production of prints that can be viewed by transmitted or reflected light is now available from *Supreme Photo Supply Co.* Called Transcolor, it has a high-gloss front surface and a matte back which lends itself to hand coloring or lithographic printing. The bromide emulsion film should prove very useful for the making of advertising displays and unusual panoramic effects in black and white or color.

Wide Spread Light **109**

Three additional sizes of Conelites have been added to its regular line of lighting equipment by *Mole-Richardson Company.* The lamps are similar



to the 1000 or 2000-watt Junior Conelites but will accommodate 500-watt, 750-watt, and 5000-watt globes. The Conelites are designed to furnish a wide spread of soft-toned illumination which is chiefly used as "fill" light over larger areas. Heavy duty stands on caster bases are available for use with the light units.

Lamp Support Clamps **110**

A cast aluminum clamp, its powerful jaws designed to hold on to just about any chair, board, or partition, is now available from *Natural Lighting Corporation.* Called Gaffer Grips, the units are available in several models.

Engineered for Peak Production

SIMPLEX SUPERGLOSS

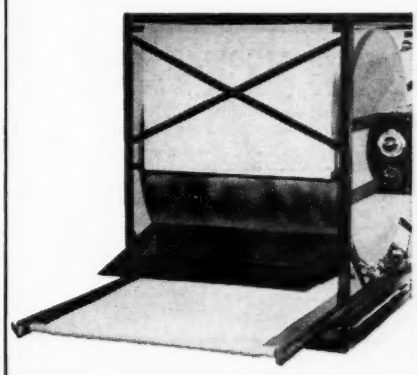
Precision engineered and designed for the busy laboratory where volume production is essential.

Has 2400 square inches of drying surface.

Capacity 350 8 x 10 S. W. prints per hour and will take prints up to 26" wide.

Has thermostatic heat control, seamless chromium plated drum and positive chain drive.

Gas or electric heat



SIMPLEX HI-GLOSS

A Table model dryer that meets every requirement for quality and quantity production.

Highly polished chromium plated seamless drum. Thermostatic Heat Control Variable drum speed.

Capacity: over 135 8 x 10 S. W. prints per hour and takes up to 16 x 20 prints.

Write for complete details—

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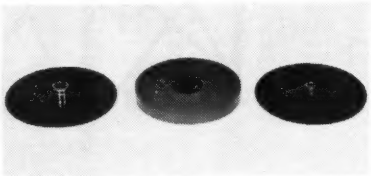
The Model GAG has a 5/8" stud and will support lights of the largest Color-Tran size and also baby kegs. The Model GBG has a universal swivel mount with special spring-loaded brass fittings. The cast aluminum grips also feature high friction rubber grips within the jaw which are permanently affixed and will not mark the gripped surface even after prolonged usage. Price: GAG, $6.90; GBG, $8.90.

Fastax Reel 111

Quick loading of darkroom package lengths of 16mm film for use in *Wollensak Optical Company's* Fastax high



speed cameras can now be done rapidly with the use of the WF-371 Split Spool. The spool which accepts film pre-wound on the type T film core may be used as a supply or take-up spool. When used for take-up, the exposed film may be removed by means of the WF-372 Ejector which removes the T core with the film in place.

Background Papers 112

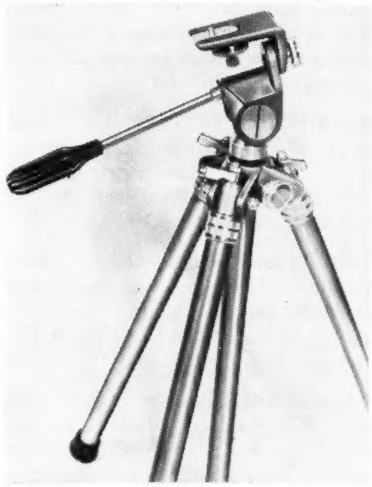
Phototec, Inc., manufacturers of the Roll Easy Background Roller, now have available a series of background papers designed exclusively for photographic use. They come in gray, tan and blue and are core-wound ready for use in convenient 9 and 12 foot widths.

Improved Easel 113

The 11 x 14 Omega Automatic Easel originally introduced in 1955 has undergone a bit of redesigning to make it even more useful in the darkroom. The *Simmon Omega* product now has additional paper stops at the top and side to insure border perfection and new lock screws of nylon which cannot scratch the metal. For quick adjustment of blades, nylon slides are provided below the blades which give a gliding smoothness for easy adjustment. A tilting attachment to correct negative distortions is also available for the easel. Price: $67.50; Tilting Attachment, $10.60.

Fast Setting Tripod 114

A unique locking system which permits instant opening, adjustment and locking of tripod legs is the outstanding feature of the latest *Safelock* Flip Lock Model FL tripod. The unit which extends from 25" to 59" also has a reversible center column. The



Flip-Lock lever which is positioned over each tripod leg operates a positive acting foolproof device built into each leg. Telescoping action takes place from the top up and eliminates the possibility of carrying mud, sand or water within the leg. Weight of the Model FL is 4½ lbs. Price: $24.88.

Automatic Film Processor 115

Superior film uniformity is said to be offered by the Lithoflo Graphic Arts Film Processor now manufactured and marketed by *LogEtronics, Inc.* The manufacturer has added to the original Lithoflo a closed-circuit control system which automatically agitates, filters, and circulates the developer, in addition to maintaining its temperature within + or −½°F. Daily outputs from 100 to over 1000 negatives are possible with the new Lithoflo which will accept all sizes of cut film from 8" x 10" to 20" x 24". Other new features include new type tension bar springs, fiberglas bearings, Delrin drive gears and a stronger pulley shaft.

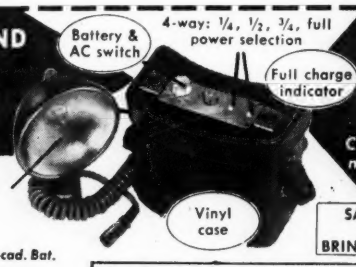
Improved Sheet Film 116

Ilford's FP3 all purpose panchromatic film has now been released in an improved form and will be known as the Ilford FP3 Series II Film. With an ASA speed of 125, the medium speed film is said to yield excellent gradation wherever considerable degrees of enlargement are required and high speed is not essential.

Continuous Projector 117

Another entry into the growing field of 8mm sound is represented by the Videotronic 8 continuous automatic projector recently introduced by *MPO Videotronics.* The completely portable machine which weighs only 18 pounds has a 9¼ x 11¾" TV type rear projection screen and a fully transistorized distortion free amplifier. A major in-

200 WATT SECOND
Portable Transistorized
ELECTRONIC FLASH
WITH QUALITY FEATURES



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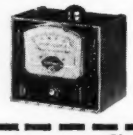

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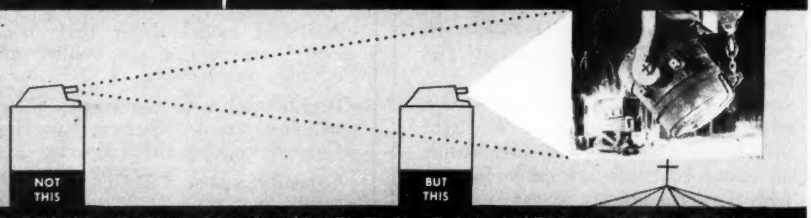

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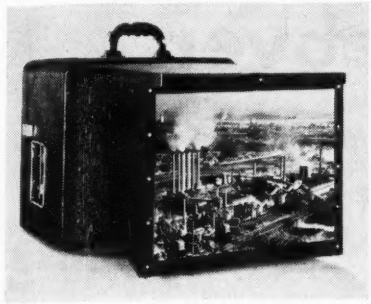
novation claimed by MPO is the exclusively designed magazine. This is held in place by patented guide arms



that shape the film coil within the magazine to create an open space between the film coil and center core. Film feeds into the projector from this friction-free space which is said to decrease tension by over 300%. Conventional projection is also possible at the flick of an internal mirror.

Economical Copier 118

Ozalid Division, General Aniline and Film Corporation has announced an extremely compact office copier which is recommended for use in all departments where on-the-spot copies are needed rapidly. The Transferon 9 Convenience Copier accepts the original and copy material at the front of the machine and delivers them from a return slot. Developer is supplied in a cartridge which automatically fills and empties the developer section as needed. When required, a handy lighter-darker indicator simplifies setting the exposure speed. The Transferon is cased in rugged, high-impact styrene in a variety of colors and works from standard 110 volt AC.

Telephoto Lens 119

A medium telephoto which combines fast speed and superior color correction with fully automatic operation is available from *Exakta Camera Co.* The *f*/2.8 80mm Zeiss Biometer is the first of a series of new five-element telephotos with instant reopen diaphragms. Diaphragm stops range from *f*/2.8 to 22. and minimum focusing distance is 2.8 feet. All numerals are clearly engraved in white on a black finished barrel. Price: $139.50.

Slave Flash 120

An inexpensive compact, remote controlled flash unit has been introduced by *Eastman Kodak Co.* The Kodak Electric-Eye Remote Flash Unit weighs less than 6 ounces and folds for easy carrying in gadget bag or coat pocket. A couple of these units should certainly be valuable on any assignment. Many features have been packed into this tiny unit such as standard tripod sockets located on op-

continued on page 96

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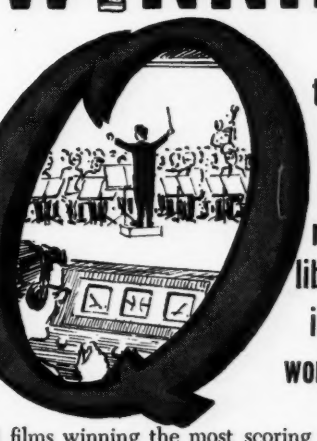

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IP Test Run

Fotorite Gets Onceover

Rapid processor is put through paces by packaging plant photo unit.

by MARTIN C. DOOT
Photography Supt.
Visking Co., Div. Union Carbide
Chicago, Ill.

We're a major producer of cellulose sausage casings and food overwrapping materials. Our four-man $30,000 lab turns out what most commercial photographers consider a good day's business — an average of 400 prints a day — and at least 80 per cent are on a rush basis.

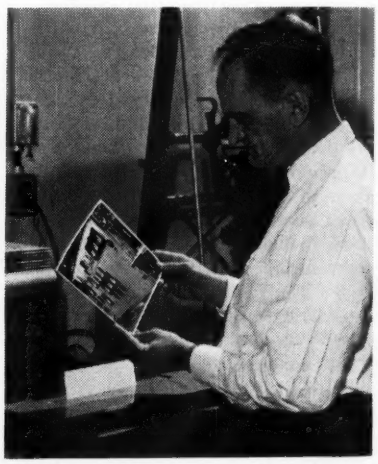
This work originates from the art, engineering, publicity and personnel departments. Since time is an important factor we decided to give the Fotorite rapid print process a trial run.

Our first test of the unit — which consists of tabletop processor plus special chemicals and papers, was in producing artist's makeovers. Makeovers are contact or enlargement reprints from a retouched 4 x 5 negative of a customer's package design. The machine enabled us to get the prints back to the artist more speedily, with no quality loss. Prints take a maximum time of 15 seconds to produce.

Next we tried the set-up on line work. At one end of the Robertson 24D copy camera a technician set up the copy board. At the other, inside the darkroom, his partner shot, slipped the exposure into the unit at his side, and pulled out a negative print. Then he gave it to the first man, who set up the negative for copying. (No darkroom needed for making contacts.)

Within five minutes the darkroom man had put a positive exposure through the Fotorite, and emerged with the finished print, ready to be pasted into the final art for the engraver.

Engineers often call on us to make photos of machines they have built for shipment to one of our six branch plants. These step-by-step shots tell the master mechanic at the machine's destination what to attach to what.



DOOT put Fotorite through workout.

Other tests the processor passed with flying colors were the production of employee portraits and mug shots as well as in recording the contents of export shipments. These photos are accepted by customs officials as proof of contents without costly unpackaging of the crates.

We have now purchased a Fotorite and I calculated it saves us four man hours a day — a lot of money over the weeks, months and years. □

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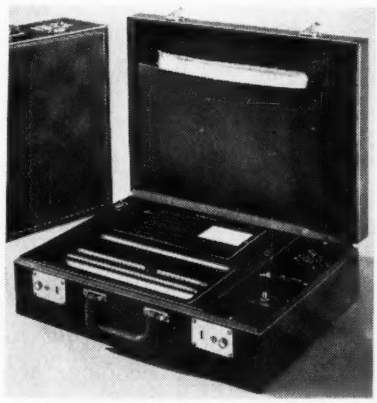
IP Test Run

A Copier For The Man On The Run

The Anken Attache, a natty 12½-lb. photocopier in leather carrying case, is primarily designed for the businessman and professional who must gather information in the field. Although we had no chance to put the Attache to this use, it behaved admirably in our office — making clean black-and-white copies of letters, newspapers, wall paper as well as functional reproductions of photos.

Using the diffusion transfer process, the machine copies any color from single sheets in sizes up to 8½ x 14. The sheets travel around rotary exposing and processing sections which can be operated in all but very bright fluorescent light. A plastic bag holds the premixed chemicals

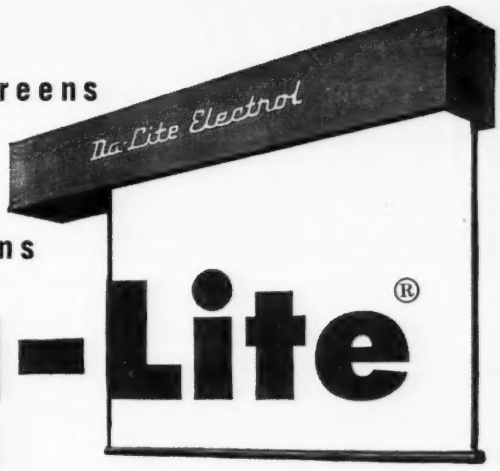


ATTACHE ready to go.

which flow by gravity into a processing tray, and back to the bag after use.

The chemicals bag is easily loaded into the machine and disposed of — requiring a change about every two months. A dial varies exposure time, although one setting takes care of most jobs. The Contoura Attache (with flatbed and rotary printing facilities) permits copying from books and should be of particular use for inplant men who wish to reproduce from books. Price: Attache, $149.50; Attache Contoura, $199.50. □

Projection screens for business Audio-Visual Communications



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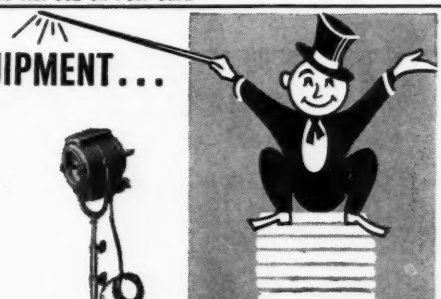

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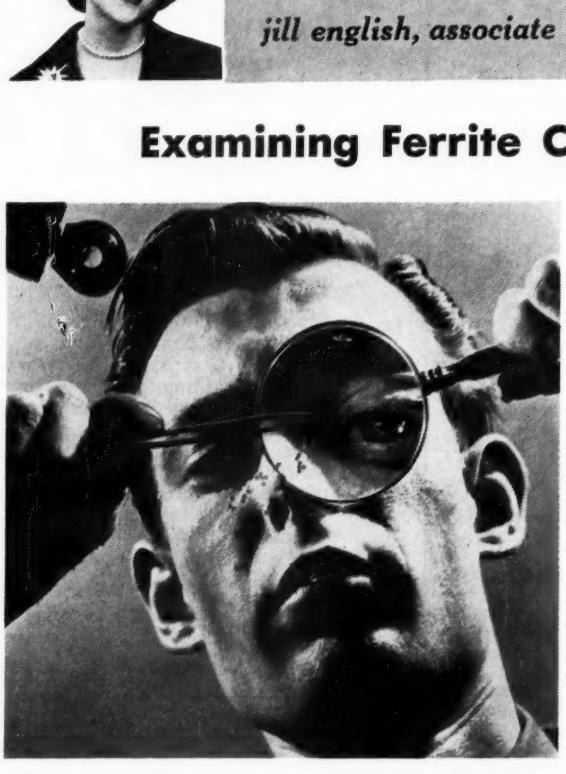
photo briefs

jill english, associate editor

Examining Ferrite Cores



LOCKHEED TECHNICIAN is caught examining cores less than 1/64-in. in diameter by Rolleiflex placed beneath sheet glass on floor. Two #5 flashbulbs pointing downward on subject and a +1 close-up lens were used for shot by plant photographer Hal Denstman.

British Professional Clan Passes Sixtieth Birthday

Claiming to be the largest organization of its kind in the world (with a membership of 3,600) the Institute of British Photographers marks its Diamond Jubilee this year. Although in the early days the majority of the members did portraits, the largest group in the Institute today specializes in industrial, medical and advertising work.

During its 60 years of existence the Institute has set standards emulated by professional photographic organizations throughout the Commonwealth. The educational program and the professional qualifications it has instituted have helped to raise the status of photographers in the United Kingdom to a point unthought of at the beginning of this century. The I.B.P. is also a member of "Europhot", the organization of European Professional Photographers, and close contact is maintained with the Professional Photographers of America Inc., which recently gave the Institute a citation for outstanding leadership.

The first meeting of the Institute, originally known as the Professional Photographers Association, was held in Fleet Street, London, in March, 1901, and was convened by Thomas Bedding, a Fellow of the Royal Photographic Society. Bedding, at that time the editor of *The British Journal of Photography,* was elected the first president of the new association, and by October of that year its membership was listed as 422.

To ensure the highest standards the Institute introduced an educational program in 1938 — the first preliminary examination being held in 1942. Full training has been extended to cover a wide and thorough syllabus and covers a period of three years, including two further examinations, the Intermediate and the Final. The Institute is the only statutory body for professional photographers in Britain and is in

close touch with the Ministry of Education and many other government departments.

In 1938 professional qualifications were instituted and since then Fellowships and Associateships have been awarded — although sparingly — to members of the profession on the basis of personal achievement in varying specialist fields.

These activities have helped maintain the high standards of photography in Britain. Another educational project is the dissemination of technical and scientific news to help members keep abreast of their field.

Mobility Sales Technique For High-Speed Camera Firm

Mobility — one of the key factors in the space age — has become a marketing technique for defense and industrial capital equipment manufactured by Benson-Lehner Corporation of Santa Monica.

The company has a demonstration laboratory on wheels christened the Data Cruiser and equipped with a data processing installation and executive conference room. Among other things, the equipment in the Data Cruiser will be used to give demonstrations on processing graphic engineering data to and from a computer. Units aboard include a magnetic tape converter, an electroplotter and an Oscillograph Analyzer Recorder, as well as a variety of high speed photo instruments and a correlation system for instrumentation cameras.

New SPIE President

SOL TIFFEN (R), Tiffen Optical Co., receives the gavel and plaque symbolizing the presidency of the N.Y. chapter of SPIE from Past President Chet Engvaldsen.

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sipley on patents

dr. louis sipley

Director of the American Museum of Photography

Polaroid (And Others) Gain Color Patents

One can assume that Polaroid's eggheads inched closer to hitting the jackpot — creating a marketable color film — with the filing of another color patent recently. Other big companies were issued color photographic patents too, making a grand total of six new patents in this area filed during September.

In *U.S. Patent 2,997,390,* issued to Edwin H. Land and assigned to Polaroid, a process is described for obtaining color images by the diffusion-reversal technique. A color image is obtained by a multi (three) layer photosensitive element. Each layer contains color-providing substances in the form of polarizing crystals, in addition to the color-sensitive emulsion. All are molecularly oriented and dispersed in a suitable carrier medium whereby they exhibit dichroism (the property of presenting different colors in two different directions, by transmitted light).

In use, this photosensitive film results in the formation of a positive color image when subjected to a processing composition after exposure. The complete color image may be transferred by imbibition to an image-receiving layer. This may be done within the camera, the photosensitive element having been exposed through the emulsion side and then brought into contact with the processing composition and image-receiving layer together.

Outside Camera

Or it may be done outside the camera after exposure by spreading the processing composition over the surface of the photosensitive element and then pressing it into contact with the image-receiving layer.

Imperial Chemical Industries Ltd. of London has acquired *U.S. Patent 2,998,312 — A New Process For Colour Photography.* The inventor considers this patent an improvement over British specification No. 637,091 where the magenta-former in a three-layer color film consisted of a homogeneously distributed water-soluble yellow styryl dyestuff.

In this patent the magenta color couplers are colorless and derivatives of reactive methylene compounds. They permit the formation of masking images of correct intensity after the development step without any serious effect on the speed of the color development, since the speed of this development is appreciably higher than that of the corresponding styryl dyestuff.

Du Pont Patent

In *U.S. Patent 2,997,388,* Du-Pont has protection on the invention of a new process for the color correction of subtractive color images in duplicating negative and master positive films. This is based primarily on multilayer photographic color films, using the negative-positive method, having an integral masking or color-correcting layer.

It is intended to use available commercial apparatus and equipment. In contrast with a simple three-layer color film, this new process includes an auxiliary silver halide emulsion layer in contact with at least one of the usual three emulsion layers. The extra layer is primarily sensitive to light of a region in the visible spectrum which will not expose any record layer to be corrected. This may contain an orange color former.

U.S. Patent 2,994,607, from Agfa, relates to multi-layer color processes in which color images are formed by the dye-coupler method.

related reading

GUIDE TO 120/620 CAMERAS By Rus Arnold. Chilton Books, 128 pp., $1.95.

It may be that the photos you've been looking for have been here all along – in the 120/620 roll-film cameras.

Arnold points out in his introductory chapter, that the entire process of photography with 120/620 cameras is a comparatively simple achievement (from the first shutter snap to final printing or enlargement). Thus professional photographers have tended to ignore its advantage as a Jack-of-all-trades camera, the use of which saves the 35mm and larger cameras for really specialized work.

This latest addition to the Modern Camera Guide series is a worthwhile addition to your photo library, valuable alone for its detailed suggestions for darkroom techniques, hints for portrait work and location cameras and its major theme – that the 120/620 cameras are worth another look (long-range and close-up) by the professional photographer. – P.K.

EDUCATORS GUIDE TO FREE FILMSTRIPS, EDUCATORS GUIDE TO FREE FILMS and EDUCATORS GUIDE TO FREE TAPES, SCRIPTS AND TRANSCRIPTIONS Educators Progress Service, Randolph, Wisc.

These three directories attest to the vast quantity of free audio-visual materials being offered by industry and the government. The grouping of free films might be of interest to management planning a film program for employees, while the tape listing could prove useful to the moviemaker. For instance, the State Historical Society of Wisconsin offers a series of tapes about the history of that state.

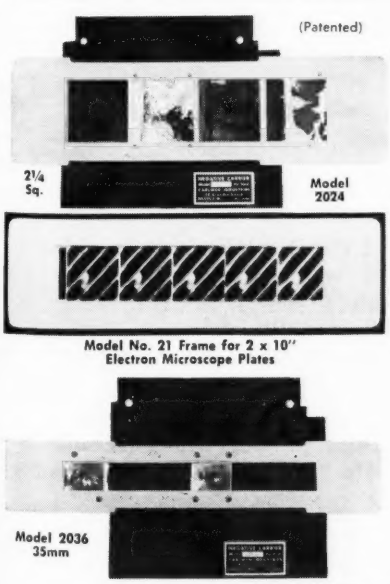
MCGRAW-HILL FILMSTRIPS, MCGRAW-HILL TEXT FILMS McGraw-Hill, 330 W. 42 St., N.Y. 36, N.Y.

Filmstrips and movies sold by McGraw-Hill are listed in this pair of references. Although intended primarily for educational use, there are categories of materials for adult use.

FOCAL ENCYCLOPEDIA OF PHOTOGRAPHY DESK EDITION. The Macmillan Company, New York, N.Y. 1,298 pp. $6.95.

One of the most useful photographic books you can own. You can find the answer to any question about photography as easily as you can look up a number in the telephone book or a word in the dictionary. All 2,000 entries are arranged alphabetically. Highly recommended.

Written by 197 international experts, this book gives you in one volume a complete photographic library, including a guide to equipment, materials and methods; a lexicon of photographic terms; a source book on art and photography; a manual of applied techniques; a biographical dictionary; an international survey of photographic business and a guide to historical references. All of this *plus* a six-page trouble-shooting guide to the causes and cures of 110 common faults with negatives, prints and mountings.



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MICRORECORDING AT WORK

continued from page 44

for industry. Yet many libraries today have considerable holdings in micro form. Even more libraries offer microfilm to the user in place of loan of the original.

The Microreproduction Laboratory at M.I.T. is the result of recognition on the part of the M.I.T. libraries, a number of years ago, that photographic techniques could successfully supplement the established library activities. The author has been head of the Microreproduction Laboratory for about seven years during which the laboratory has grown rapidly in size.

The laboratory has two functions: service and research, and in the author's opinion efficient service is most easily achieved by combining production with a certain amount of research and investigation. The laboratory is also involved in the academic process of M.I.T.

The Microreproduction Laboratory offers duplicates of information available at M.I.T., primarily that contained in the libraries, to all authorized users. Requests for microfilm, electroprints (Xerox), and photoprints are received from all over.

The laboratory is also involved in microphotographic systems related to administration, registrar's records, accounting department files and others. Special technical films of bubble chambers and scope screens which are related in their requirements to microfilm are also processed.

Extensive files of negative master films are housed in the Microreproduction Laboratory for quick duplication onto positive film on request. The great majority of all requests are now completed by the laboratory in one day. The laboratory employs a clerical staff who do their best to interpret the many incomplete and erroneous references which are received.

The prevalence of requests running to no more than a few pages makes it a considerable challenge to operate large continuous equipment like the Xerox Copyflo successfully and economically. By reserving a camera for electroprint (Xerox) requests many small requests are essentially made into one large request. Thus the basically high cost of handling individual small requests is reduced.

The laboratory's equipment is second to none. In addition to the Copyflo, the laboratory utilizes a high-speed, highly controllable microfilm processor of the latest type, and film is processed at a rate of 35 to 50 fpm. Careful quality control is exercised during processing and, subsequently, all

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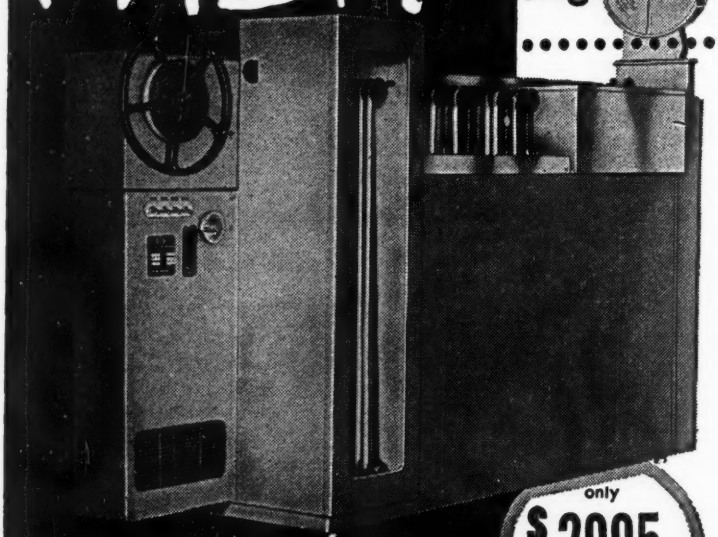

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film as well as prints are tested chemically for archival permanence; film is subjected to the Crabtree-Ross test. The laboratory has suitable densitometers, sensitometer, microscope and other equipment needed for quality control and for evaluation of new and improved products.

The laboratory pioneered the use of Kalvar microfilm in non-government application. Kalvar microfilm, which is a contact print film, is particularly suitable for a laboratory of this type since the film is dry processed and a stable film is created instantaneously. This is particularly useful for duplication of theses, which are kept in the laboratory in the form of master negatives.

Complementing the basic staff of the laboratory, a number of M.I.T. students are employed in the laboratory on a part time basis.

In cooperation with the department of Mechanical Engineering a number of theses have been written in the laboratory on subjects related to microphotography and photoduplication. These have included topics such as microfilm readers, a page transport, a portable microfilming kit and others. The students are given not only the specific requirements of their thesis but also a general background in microphotography, which makes their project more stimulating.

During the winter, bi-weekly seminars are held for the technical staff of the laboratory. These cover theoretical and business aspects of microphotography, and other topics such as lens aberrations, latent image theory, theory of development, color theory, theory of the different processes involved in documentary reproduction: silver, diazo, Kalvar, electrostatics and many others. A small photographic library is also at the disposal of the laboratory staff.

In a field where new machines and new processes appear almost daily, efficiency includes frequent examination of new products,

continued on page 95

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roundtable

continued from page 16

for ease of photographing. A title, if used, should supplement not duplicate information given elsewhere on the slide, but still be an integral part of the idea to be conveyed.

A graph should be designed to require minimum mental effort on the part of its viewers. It should be free of all lines and lettering not essential to the viewer's clear understanding of its intended message. This is illustrated in *Figure 1*.

Curves

Four styles of curves are illustrated in *Figure 2*. Of these four, styles one and two are preferable for use on slides. However, in using grid lines refrain from using cross-sectioned paper if possible. If it is absolutely necessary to use cross-sectioned paper, the color is important. With orange-colored ruling, all ruled lines on the paper will show black in a photographic reproduction. Under these circumstances, any lettering placed on the chart will be reproduced on the slide with grid rulings running through it (both in black), and the lettering will be much more difficult to read than on the original drawing. To avoid this, legends may be lettered on strips of sticky back paper, and pasted on top of the cross-sectioned paper.

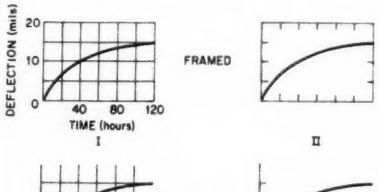

Figure 2

Not more than three or four curves should be shown on the same graph. The presentation of many interlaced or unrelated curves on the same graph should be avoided.

Lettering and numbering on a graph should be placed so that it is easily read from the bottom and from the right hand side.

Choosing Scales

In choosing scales for a graph intended for slide purposes, special care is needed since scales have a controlling influence on the apparent rate of change of the dependent variable. In *Figure 3* two graphs are shown giving frequency-response characteristics of a condenser microphone. Greater significance would be attached to the variations shown in the upper graph, while little significance would be attached to the variations shown in the lower one. Therefore, the upper choice would be feasible if the speaker wished to show that the response varied 2.75 DB over the audio-frequency range shown; or the lower choice if he wished to show that the change in response was barely perceptible to the ear over the same range of frequency.

Curves should preferably be represented by solid lines. When more than one is represented, differentiation can be accomplished by solid, dashed or dotted lines. All colors are to be avoided since they confuse rather than add to the presentation.

For plotted points, plus signs or crosses should not be used. Instead, circles, squares and triangles are applicable. Filled in symbols may be desired in scatter diagrams for purpose of contrast. Filled-in circles should be made smaller than those not filled in.

All curves should be identified when practicable by using brief labels placed close to the curves rather than letters or numbers. □

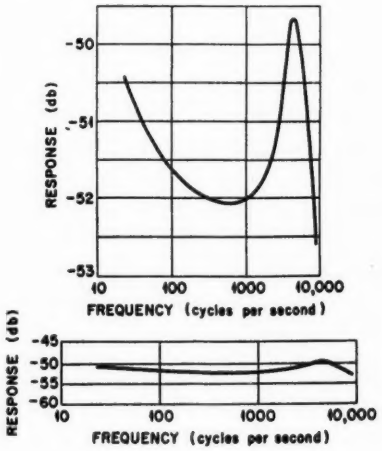

Figure 3

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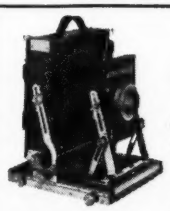

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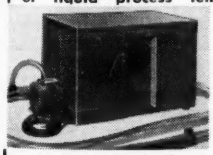

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microreproduction

continued from page 93

machines and systems, and appraisal of their merit.

M.I.T. has just received a grant from the Council on Library Resources for a research project to be carried out jointly by the Microreproduction Laboratory and the company of Edgerton, Germeshausen and Grier. The project is to design a microfilm system providing a film and a Finder-Reader which will enable the user to read an index consisting of captions, words or symbols while the film is in motion. It is hoped that this system will greatly enhance the use of roll microfilm.

The laboratory has also engaged in surveys of user reaction to new micro forms, the most recent an experiment in the use of microsheets for all reading material in a mathematics course.

The library does not have the equivalent of the aperture card in industry. The aperture card, designed primarily for storage of engineering drawings, has so far been too expensive for library storage of normal scientific material. A less expensive aperture card would certainly be of interest to the library and it would fall in with the increasing interest shown by libraries in punched card equipment for business operations.

The laboratory is interested in the various types of rapid copying machines, all of which are somewhat wanting with respect to book reproduction, and advises divisional libraries and other departments of M.I.T. on the merit of such equipment.

Projects in the laboratory during the last few years have included appraisal of copying machines, study of various aspects of permanence of microfilm and standards and tests pertaining to archival quality. The author feels that standardization is an extremely important preliminary to further maturing of the microfilm industry. □

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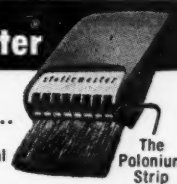

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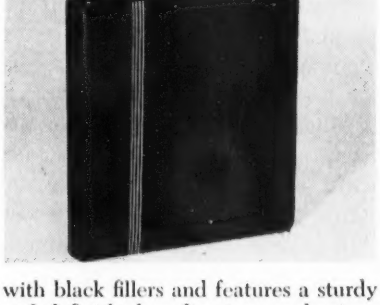
new products

continued from page 85

posite sides of case, a mechanical safety button which insures against firing as bulbs are inserted and a safety circuit which prevents flashing of the bulb by an increase in the overall room light. Powered by pen light cells, the unit is sufficiently sensitive to be used within a distance of 25 feet from the main light source. The transistorized slave unit will accept M2, M5, M25 and 5 and 25 flash bulbs. Price: less than $20.00.

Sales Aid 121

An attractive album specifically designed for sales presentations is available from the *Camille Company, Inc.* The TV-810 which is available in several colors and sizes is covered in washable pyroxylin-coated fabric over heavily padded boards and is handsomely gold stamped. Sufficient space is available to accommodate up to 25 acetate pages, or enough for 50 photos. The TV Series comes complete with six heavy duty acetate pockets



with black fillers and features a sturdy nickel finished multo-ring mechanism.

Push Button Copier 122

A diffusion transfer photo copier with capacity up to 15-inch width has been introduced by *Photek Inc.* Features of the machine include clean handling and a new disposable plastic cartridge which contains the necessary chemicals. Developer life is said to be significantly extended in the airtight cartridge which holds 48 ounces of fluid. The attractively designed machine known as the Expediter 15 also features roller feed for copy and matrix for added convenience. Price: $149.50.

Power Supply 123

Remote location operation of motion picture cameras, recorders, and lighting equipment is made easy with the introduction of *Gordon Enterprises'* CARon Mobile Power Unit for generating 110 volt AC. Resembling a regular automobile generator, the Unit may be installed on any car engine and is driven by the fan belt from the water pump, crankshaft or DC generator pulleys. In addition to the engine mount, a dash-mounted panel contains an on-off switch, voltmeter and throttle regulator. Two models are available: The Model A for 12 or 24 volt systems giving 30 amp capacity; and a Model B for 6 or 12 volt systems with a capacity of 22 amps.

Precise Timer 124

An automatic timer that can be started, stopped and reset by remote means has been developed by the *Industrial Timer Corporation.* Measuring intervals down to 1/100 of a second, the ESC features a unique cone clutch

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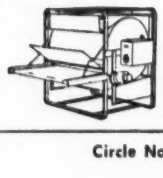
APRON WIDTH 22 in



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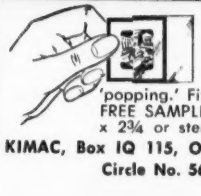

Skin-tight, sealed, square-fold Kodapak sleeves. Prevent scratches, fingerprints, abrasion, frayed edges and 'popping.' Fit all viewers and projectors. FREE SAMPLE. Specify size: 2 x 2, 2¾ x 2¾ or stereo. Give dealers name.
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which engages the pointer mechanism with the synchronous motor. Engagement is so rapid that there is no lag between start and engagement. An additional feature of the unit is the solenoid-operated pointer reset which completes a full dial reset in approximately 100 milliseconds.

Versatile Light Unit 125

A lighting control unit for motion picture and commercial photography which features a split load input has been introduced by *Natural Lighting Corp.* Called the ColorTran Senior Mark II, it may be operated from a single 30 amp. AC power source, or from two individually fused 15 amp. sources. This feature is especially valuable when the Mark II is to be used on low current circuits when these are the only ones available. The unit will boost ordinary 120 volt lamps to produce light at 3200 degrees Kelvin or 3400 degrees Kelvin. Other features include recessed carrying handle, twist lock type power outlets, and three-wire safety-grounded wiring system. Weight: 33½ pounds. Price: $120.

Titling Aid 126

Economical and ready-to-use raised letter alphabets have been announced by *The Redikut Letter Company.* The die cut cardboard letters are finished and patterned in a variety of colors and type faces and are exceptionally easy to use. The Redikut Letters may be applied to a background with a dab of rubber cement or Plasti-Tak—in which case they may be reused. Sizes range from ¾" to 4½" in such styles as Kabel, Broadway, and Modern Block.

Intervalometer 127

Maximum versatility for use in all applications required of time lapse photography is said to be offered by the new Sanders Time Lapse System recently introduced. The manufacturer, *Sanders Laboratories,* has incorporated a pulse generator within the system, a predetermining pulse counter to secure the desired time cycle interval and a patented electronic exposure control to provide short or long time exposures. Interval times may be varied by seconds between one second and two hours and 46 minutes. Other features of the Sanders Programmer include motorless electronic camera drive which advances the film after the exposure has occurred, an external shutter blade which permits the use of high intensity lights that must be operated continuously, an accessory exposure outlet supplying 110VAC, 5 amp. current and a separate resettable electric counter which automatically counts exposure frames.

Projector Kit 130

A complete optical kit for the construction of a compact overhead projector is being offered by *Edmund Scientific Co.* Designed to be used in combination with locally purchased materials, the kit is supplied with complete instructions and diagrams. Contents of the kit include a projection lens, condenser lens, lamp, and socket. Coverage of the optics is designed for 4 x 5" transparencies. Price: $15.00.

Tape Applicator 134

A simple applicator for pressure sensitive tapes which can be used with one hand is being produced by the *Velvet Touch Corporation.* The simple unit allows the user to roll out the tape to the desired length, then with a tilt and slight twist to cut the tape off. Any ½ inch width, 1 inch core masking, vinyl, or cellophane tape can be used with the Velvet Touch. □

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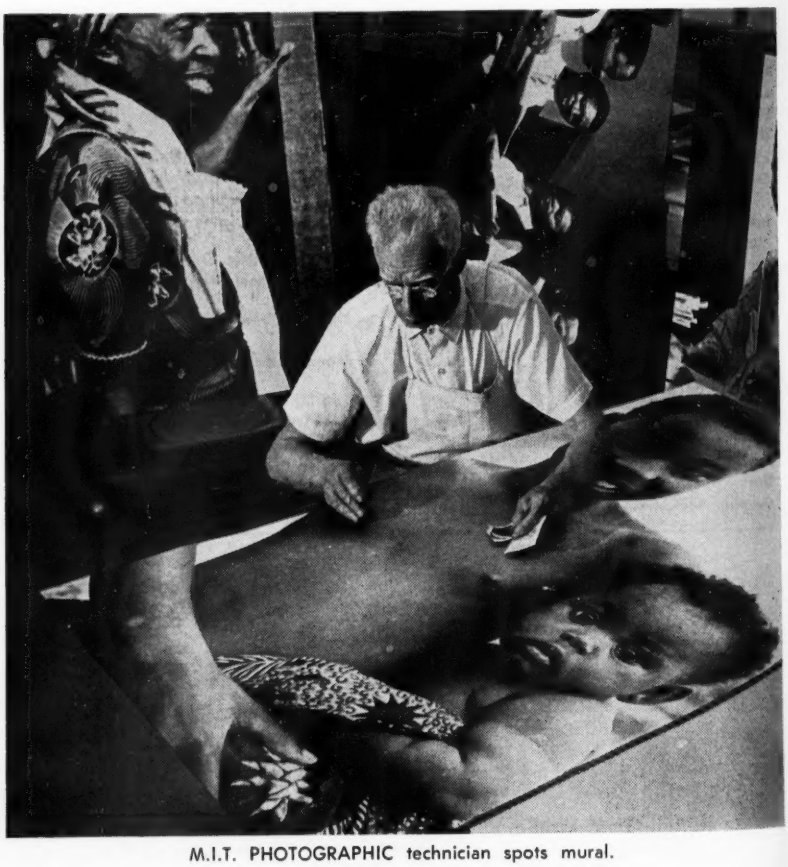
We have been very successful in the production of photo murals, our *pièce de résistance* being an eight-foot by 25-foot mural of the M.I.T. campus, made in sections on a horizontal enlarger and spliced together. It hung behind Winston Churchill as he addressed our Midcentury Convocation in the Boston Garden. But most of the orders we receive are within the 60-inch-length range and are made on a standard vertical-type enlarger, which handles up to 8 x 10 negatives.

However, within the past couple of weeks, a customer asked for prints six or eight feet in length from 35mm negatives. This called for many more diameters than we were prepared to handle with our standard equipment. A veteran member of my staff, Mr. Jackman, solved our problem in this way:

From our audio-visual department he borrowed a standard 2 x 2 projector; one, however, that had incorporated in its lens system an iris diaphragm, knowing that in this manner he could control the amount of exposure. In a relatively short distance, approximately 15 feet, he was able to project this 35mm negative and produce a result comparable to the best work we have ever turned out with other types of enlargers. The image was sharp, the quality good and the exposure extremely uniform over the entire area right out to the corners. — *Frank H. Conant, Manager, Photographic Service, Massachusetts Institute of Technology, Cambridge, Mass.*



M.I.T. PHOTOGRAPHIC technician spots mural.

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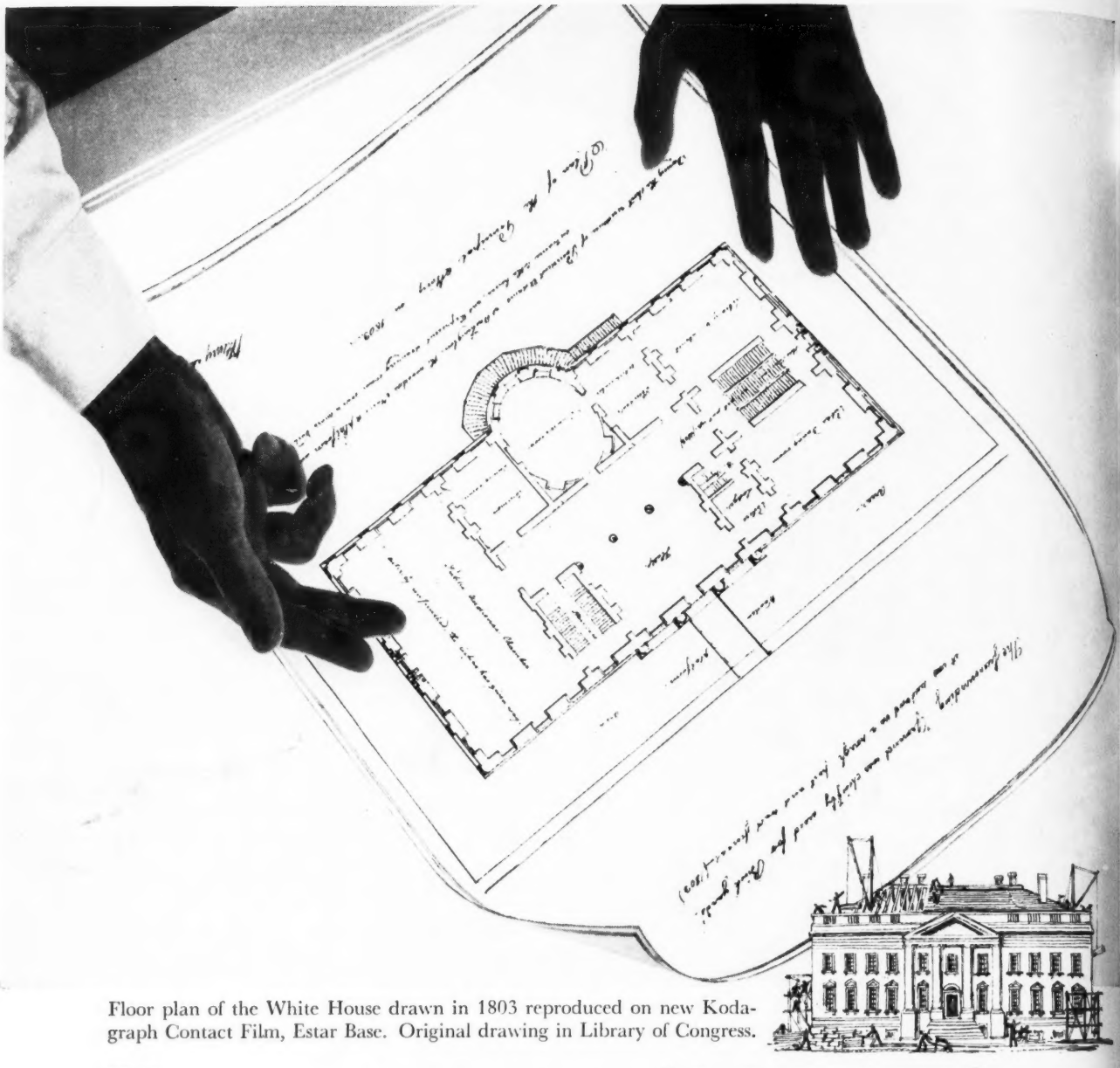

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